SEPTEMBER, 1956

B 613616

PIPE LINE INDUSTRY

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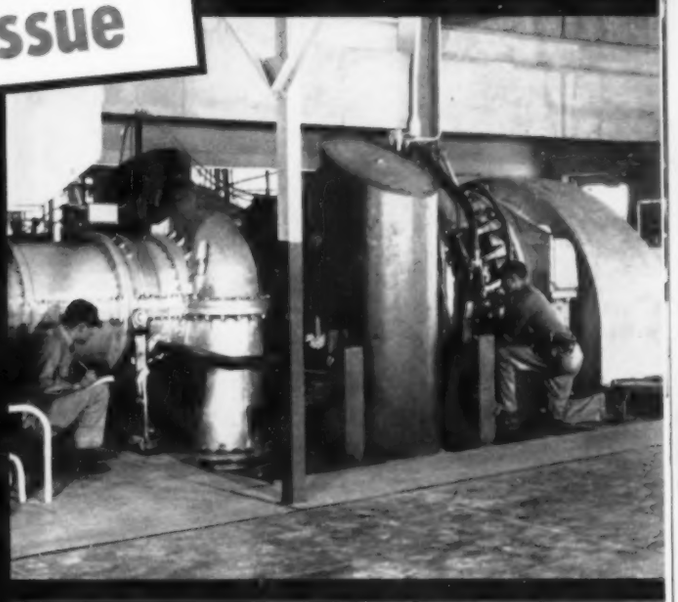
CONSTRUCTION • OPERATIONS • MAINTENANCE

Maintenance Issue

A selection of pipe line maintenance ideas to save you time and money. Here are advancements in line inspection and cleaning . . . compressor and pump station repair . . . plus top hints for equipment.



Gas Turbine Stations

How El Paso Natural Gas Company modified gas turbines to work out initial operating bugs. One idea alone may save a $45,000 repair bill. Page 34

Electrical Maintenance

Today's highly electrified pumping stations demand careful attention to power and control system maintenance. These engineering suggestions are a helpful guide. Page 40

Helicopter Inspection

Hope Natural Gas uses experienced pilots for pipe line inspection by helicopter along rugged right-of-way in mountains of West Virginia. Page 56

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OCT 5 - 1956
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PIPE LINE INDUSTRY

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September, 1956 Vol. 5, No. 3

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

El Paso's Repairmen Keep Turbines on Line

☐ Working the bugs out of 28 gas turbines during the first four years of operation produced some cost cutting answers to El Paso Natural Gas Company's turbine-compressor station problems.

A. H. Carameros ..... Page 34

Maintaining Pipe Line Electrical Equipment

☐ Today's modern stations, designed for maximum efficiency and economy, demand proper care of valuable electrical machinery for long operating life. Regular inspection, cleanliness and attention to operating procedures will pay good dividends.

Merritt Hyde and D. C. Washburn, Jr. ..... Page 40

Foreman's Repair Records Speed Overhaul

☐ To reduce labor costs and expensive oversights in station overhauls: Use check sheets in recording all repairs. Here are six sample sheets designed to save time and money. ..... Page 44

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☐ Southern California Gas Company modified "flatland" methods to clean their 22-inch pipe line through the Tehachapi Mountains. Here is how detailed planning and careful control did the job for only $650 per mile.

A. S. Olson ..... Page 48

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PIPE LINE INDUSTRY published every month. Entered as second class mail matter July 9, 1954, at the post office at Houston, Texas, under the act of March 3, 1879.

New Ownership of American Business

Blistering attacks will be made on big business during the next several months, as the two U. S. national political parties campaign for the presidency. This raises the question of just who is big business in the U. S.

Big business is not what it was a few years ago. A tremendous change has taken place. American business has a new ownership. Not too long ago stocks in big U. S. corporations were held mostly by a pretty small number of large wealthy investors. However, this is no longer true.

The number of stockholders in U. S. business firms has increased rapidly in recent years, and gives signs of continuing to grow at expanded rates in the future. Business corporations today are owned by a vast number of individuals.

•

The American people own the country's business today. According to a New York Stock Exchange survey, stock in the 4600-odd U. S. corporations with more than 300 stockholders is owned by 8,630,000 different individual shareholders. This is 33 percent more than the 6,490,000 that owned stock at the end of 1952. This is after eliminating duplication because of individuals owning stock in more than one corporation.

This means that one out of every 12 U. S. adults owns some stock in at least one publicly owned company. Four years ago only 1 out of 16 adults owned any stock.

In addition to the above, an estimated 1,400,000 persons own stocks in closely held corporations only. Hence, total number of business stockholders in the U. S. exceeds 10 million.

Owning stock in U. S. business firms no longer is a privilege reserved for the wealthy. Nearly two-thirds of the current shareowners live in households earning under $7,500 annually, one-third earn less than $5,000. Nearly 3 percent of all families earning less than $3,000 own some stock, while 28.6 percent of the families $7,500 and up own stock.

•

Even the biggest companies are owned by a large and increasing number of people. General Motors, world's largest manufacturing concern, is a typical example. Two-thirds of General Motors common stock is owned by 541,000 people, about 90,000 of whom are employed by the company. Fifteen large stockholders own the remaining one-third, including 23 percent owned by Du Pont & Company.

Standard Oil Company (New Jersey), largest of the oil companies, has 324,000 shareholders. Five years ago the company's stock was owned by only 222,000 people. Gulf Oil Corporation now has 73,705 shareholders compared with 32,336 in 1950. Phillips Petroleum Company's 90,246 stockholders today contrasts with but 53,671 in 1950.

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A big factor in the widening of stock ownership is the basic economic prosperity of the country, particularly the improvement in the low income group. However, another big factor—and a growing one—is the widespread adoption of employe stock purchase plans. Seventy-five firms on the New York Stock Exchange alone have started employe stock purchase plans since 1947.

General Motors commenced a savings-stock plan last October. Already 90 percent of more than 100,000 eligible salaried workers have invested $32 million in it, with the company contributing another $16 million. During the last six months, 32,000 salaried Ford Motor employes have invested $7½ million in the company's stock, with the company putting up an additional $3¾ million.

American Telephone and Telegraph has 250,000 employe-stockholders. General Electric has 50,000 employe-stockholders. Socony-Mobil, which started its saving plan only five years ago, now has nearly 38,000 employe-stockholders, 88 percent of its total employes. Eleven thousand of Pure Oil Company's employes are stockholders.

A great many companies, including most of the large oil companies, have inaugurated employe stock purchase plans during recent years. The ownership of American business is to continue to become more widespread, and more and more into the hands of the average American, particularly the company employe. A "people's capitalism for all" is rapidly developing in the U. S.

Warren L. Baker

Were you shortchanged last month?

● Like getting your windshield cleaned when buying gasoline from a first-class service station operator . . . you naturally expect prompt and understanding service when ordering maintenance supplies for a modern pipe line system . . . and you feel "short-changed" if you don't get it.

"Oilwell" representatives in pipe line equipment sales, fully understand your material problems and know what is needed to keep pumping stations in operation. The practical experience which they have had in the application and use of pipe line supplies qualifies them as "specialists" in this work—not mere "catalog" men.

Read this imposing list of services that assure you of full value with every order from "Oilwell."

Complete warehouse system—Well-stocked warehouses are conveniently located to serve the important pipe line centers. Inquiries are given prompt attention and deliveries are made quickly to meet your emergency requirements.

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Experienced personnel—"Oilwell" pipe line specialists have been trained to understand your material and service problems and can give you the service you require.

Quality products—"Oilwell" stocks include the best known brand names in equipment and materials, designed and approved for pipe line operations. When it comes from "Oilwell," you know it will meet your specifications.

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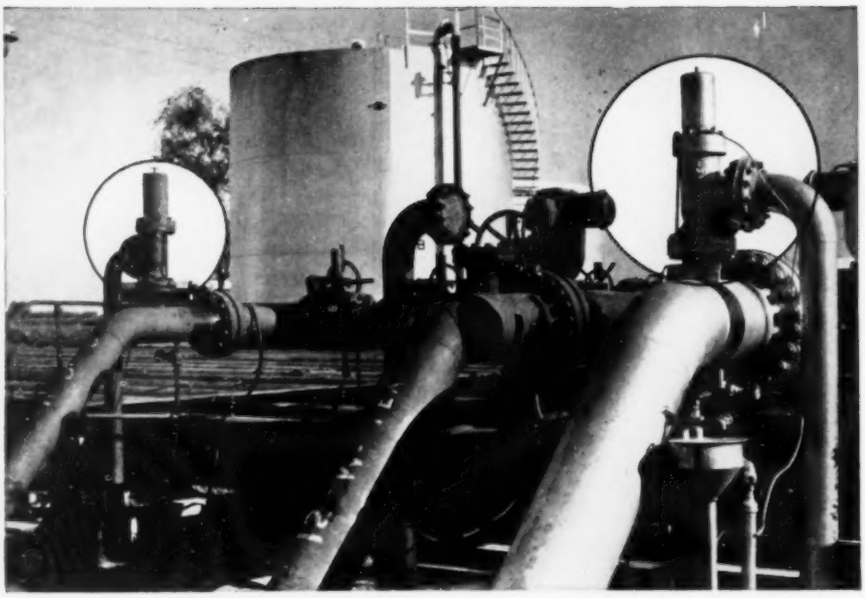
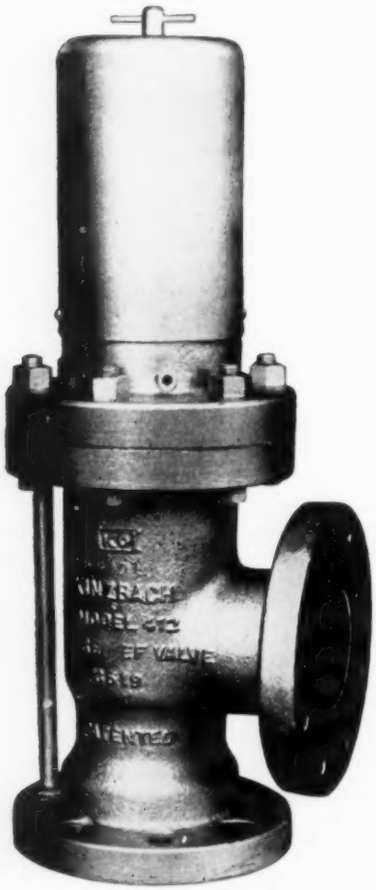
UNITED STATES STEEL



Positive Protection Against Pressure Surges



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PIPE LINE INDUSTRY

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PETROLEUM REFINER and **THE REFINERY CATALOG** for the refining-natural gasoline-petrochemical industry.

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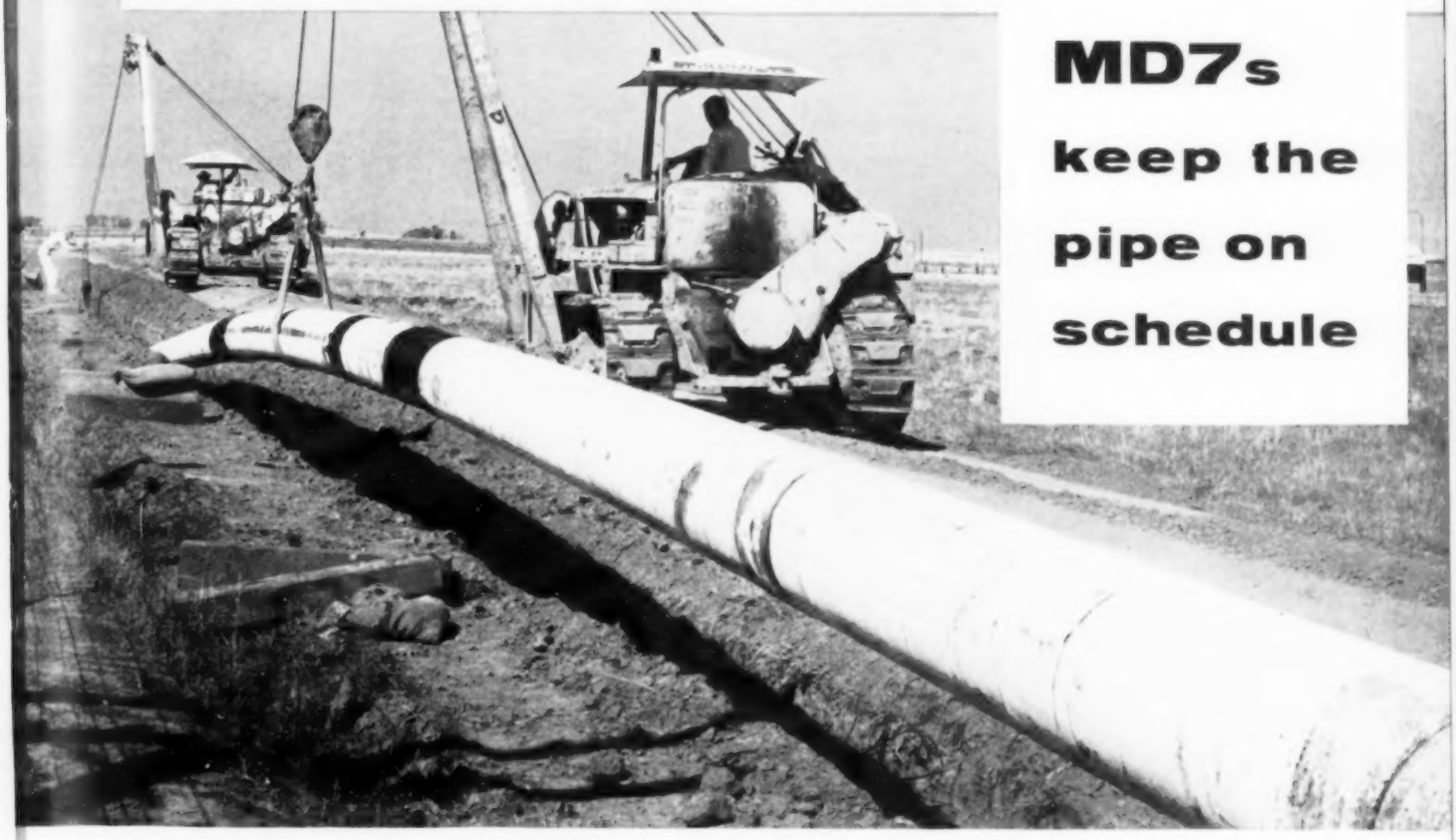
Hardpan, sand or rice fields...



MD7s keep the pipe on schedule

In the 21-mile stretch between North Sacramento Valley and Sacramento in California, the terrain includes volcanic hardpan, sand and rice fields. In this stretch, Underground Construction Co. and Stolte, Inc., used three CAT* MD7 Pipelayers to lay a 16-inch steel gas line at the rate of ½ mile a day.

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Lifting capacity is 54,200 lb. maximum. Its dependable Cat Diesel Engine puts 128 HP at your disposal. And like all Cat Engines, it can idle for hours without fouling.

But most important, this unit was designed to give you long, productive life. The exclusive oil clutch is almost completely free of time-wasting and costly adjustment and repairs. Power-boosted steering clutches and quick reversing transmission speed your job. Convenient hydraulic controls permit quick adjustment of the counterweight rack. The 18-foot boom gives enough reach to help avoid cave-ins.

You can start increasing your work speed and profits immediately. Call your nearby Caterpillar Dealer. He will demonstrate the new, improved MD7 at your convenience on *your* job.

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UNIBOLT

No threads to gall or freeze . . . No leaky seals . . . No doubt about strength — it conforms to all codes . . . No multi-bolt flanges.

Release two bolts. Swing the trap open. Take the pig out or put the pig in. Close the trap and tighten two bolts. That's just how simple and easy it is to operate a UNIBOLT Scraper Trap. An over-size barrel (slightly larger than the o. d. of the pig) makes it equally easy to start a pig. Line pressure does the heavy work.

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HELP SOLVE YOUR OIL OR GAS LINE PROBLEMS, WHEREVER YOU ARE

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1. It bends readily
2. Wall thickness is uniform
3. Line up characteristics are excellent
4. Weldability is outstanding
5. Long lengths save you time and trouble

It's no secret that installation crews prefer Youngstown Electric Weld Line Pipe for its easy line-up qualities. Good line-up is a direct result of the extra care that goes into its manufacture. To achieve the optimum in roundness, each length of Youngstown Pipe is placed in an hydrostatic expander, here, internal water pressure forces the pipe out against the solid steel walls of the mantle. The diameter of the pipe is thereby increased to a uniformly accurate size. Every length conforms to specifications—ends are truly round, uniform in wall thickness, squarely cut and properly beveled for welding. These excellent line-up characteristics are more evidence that it pays to specify Youngstown Electric Weld line pipe.

Youngstown

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THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

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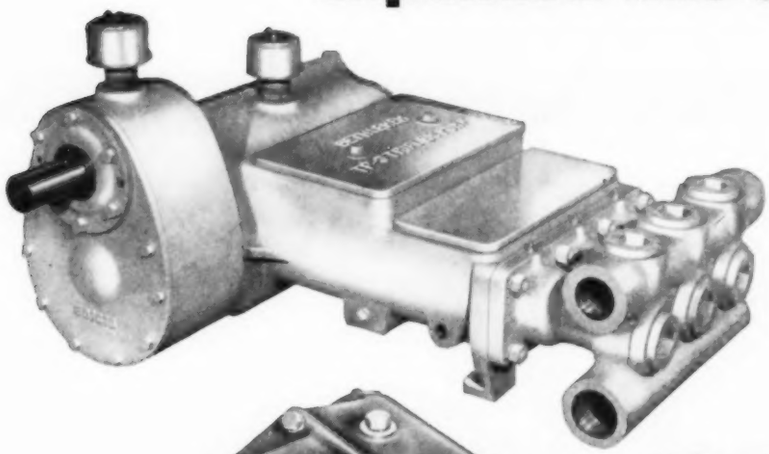
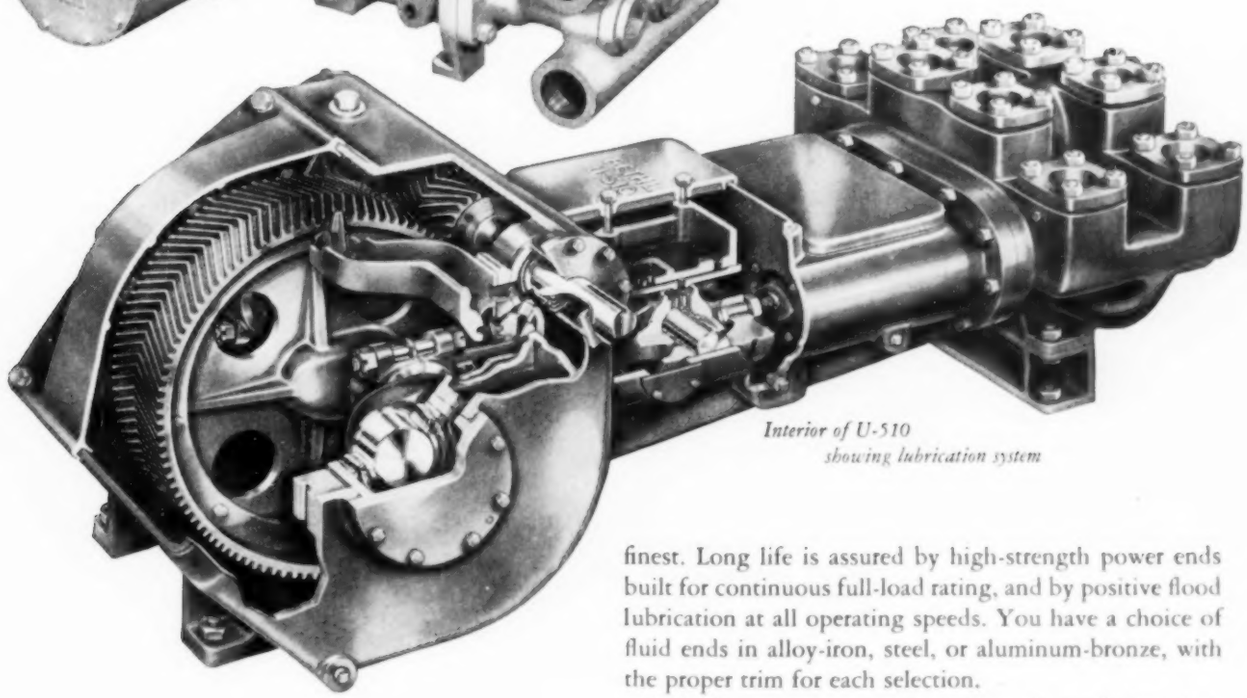
Pick your "Handy Man" from this expanded line of power pumps



TP-3 Triplex Pump



Interior of U-510 showing lubrication system

Bethlehem now offers five distinct sizes of general-service pumps, so that it's even easier to pick just the right unit. We doubt that you've ever seen a line of pumps with so much versatility. Each is a "handy man"—a pump that can readily be adapted for several different kinds of work.

Does your job involve waterflooding? Salt-water disposal? Pumping crude oil in gathering systems or pipe-line service? Pumping mud or water for the drilling rig? If the answer is yes, there are Bethlehem units that will fit perfectly into your engineering plans.

You can bank completely on the quality of these pumps. Components are exhaustively tested. Materials are the finest. Long life is assured by high-strength power ends built for continuous full-load rating, and by positive flood lubrication at all operating speeds. You have a choice of fluid ends in alloy-iron, steel, or aluminum-bronze, with the proper trim for each selection.

Bethlehem pumps are so well engineered that their salvage value is always high. We feel certain that their many advanced features will interest you. If you will write or call, our people will gladly furnish complete information.

FIVE SIZES, DUPLEX AND TRIPLEX

Model	Type	Plunger Load, lb	Input Hp	Bore & Stroke, in.
U-33	Duplex	2400	14 @ 180 rpm	1¼ to 3 x 3
UA-46	Duplex	5000	40 @ 120 "	2½ to 4 x 6
U-510	Duplex	12000	100 @ 75 "	3 to 5½ x 10
TP-3	Triplex	3580	22.4 @ 250 "	1¾ to 2¼ x 3
TP-4	Triplex	5000	42 @ 250 "	2 to 4 x 4

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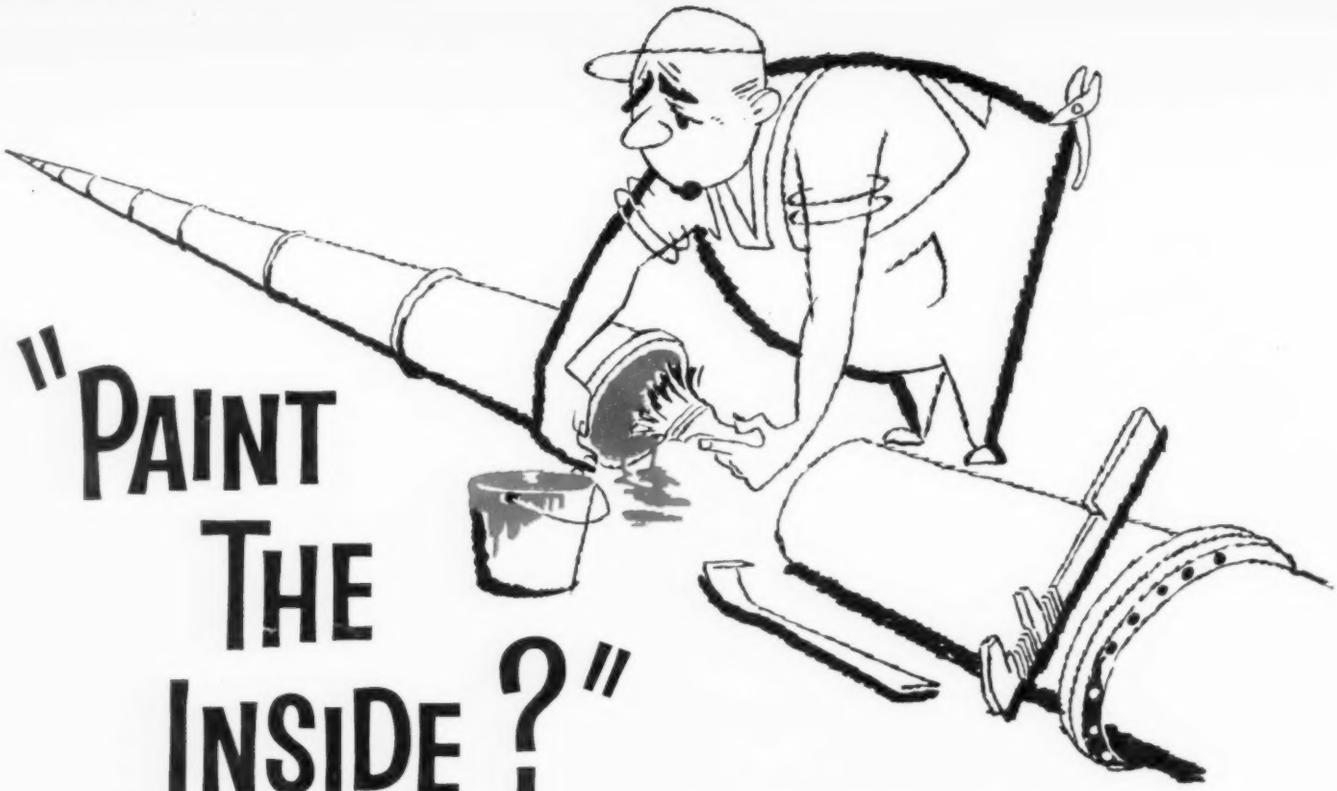

"PAINT THE INSIDE ?"

Sure you can "paint" the inside of your pipe line, but you don't need a brush (or a scraper) with UNICOR®.

UNICOR, UOP's oil-soluble corrosion inhibitor, added at a concentration as low as 10 ppm., will in effect make a rust-preventive oil of your product.

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Newport Steel

CHOICE OF LINE PIPE* USERS

*SIZES AND WEIGHTS AVAILABLE

O.D.	Wall	Wt. Per Ft.
4½	.125"	5.84
	.142"	6.61
	.156"	7.25
	.188"	8.64
	.219"	10.00
	.237"	10.79
6⅝	.134"	9.29
	.156"	10.78
	.188"	12.89
	.219"	14.97
	.250"	17.02
	.280"	18.97

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Newport Steel is ideally situated on the Mississippi-Ohio River system and the great Cincinnati rail-truck hub. New barge facilities, 7 major railroads, 143 motor carriers enable Newport to give economical, dependable delivery to the entire area of the Middle West and South.

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CORPORATION

NEWPORT, KENTUCKY

PRODUCTS OF NEWPORT STEEL . . . . . Cold-Rolled Sheets • Hot-Rolled Steel in Coil • Hot-Rolled Pickled Steel in Coil • Hot-Rolled Sheets Hot-Rolled Pickled Sheets • Electrical Sheets • Alloy Sheets and Plates • Electric Weld Line Pipe • Eave Trough and Conductor Pipe • Culverts

Toughest pipeline
whipped w
International C

Mud-matching traction, resulting from correct power-weight balance, enables the Superior Pipe-Boom-equipped TD-18 to string pipe through boggy swales without delay. New non-slip jaw-type drum clutches provide positive boom-load control.

An International TD-18 equipped with Superior Pipe-Boom is lowering-in a section of welded 26-inch line for final tie-in. Equipment at work near Chehalis, Washington, on section 16 spread of Midwestern Constructors, Tulsa, Okla.

Contractors on the job between Chehalis, Washington and Umatilla, Oregon:

Midwestern Constructors, Inc., Tulsa, Oklahoma

River Construction Co., Fort Worth, Texas

Engineers Limited Pipeline Co., White Salmon, Washington

...in U.S.A.

...d with

...al Crawlers

Veteran pipeliners on the New Mexico-Canada gasser sections between Chehalis, Washington, and Umatilla, Oregon agree: It's the roughest and toughest, ever! And they'd laid pipe in swamps and sandhills—through woods and over mountains!

Here, they had to bee-line through big timber up 55% mountain grades—cross a 16 mph river—overcome run-off mud from a record snow-pack.

They required big TD-24 "muscle" and exclusive Planet Power steering—with full *live power* on both tracks—for positive control under hazardous conditions. They demanded TD-18 safety and extra capacity —with quick pick-up, full-power traction, and handling ease not available elsewhere! That's why one spread used 19 big International crawlers.

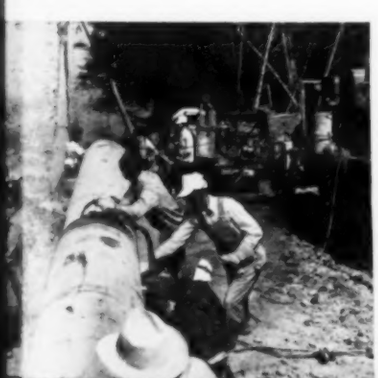
See your International Construction Equipment Distributor and prove this *tough job* power!

"Elevator" power for welding crews—one of these two Carco Winch-equipped TD-18's holds or lowers the welding "wagons"—the other helps the boom tractor on the 55% grades, to position pipe for welding.

Bending and handling pipe, to and from this bender is all International powered—a U-9 power unit on the Crutcher, Rolfe & Cummings bender—a TD-18, equipped with 70,000 lb. capacity Superior Pipe-Boom speeding the job!

TD-24's—the big crawlers preferred by mountain loggers, as well as pipe-liners, worked all over the spread—clearing land, logging heavily-timbered right-of-way—winching heavy equipment upgrade—dozing "walk-ways" for backhoes. Ease of control made the giant TD-24 the choice of operators and crewmen in danger spots!

Up 55% grades, trench-digging backhoes went to work— with the aid of Carco Winch-equipped TD-24's. Tractor anchors machine to "buck" out boulders—winches it upgrade as work progresses! One of many sideline jobs for the "winch-up" tractors is yanking boulders from the right-of-way.



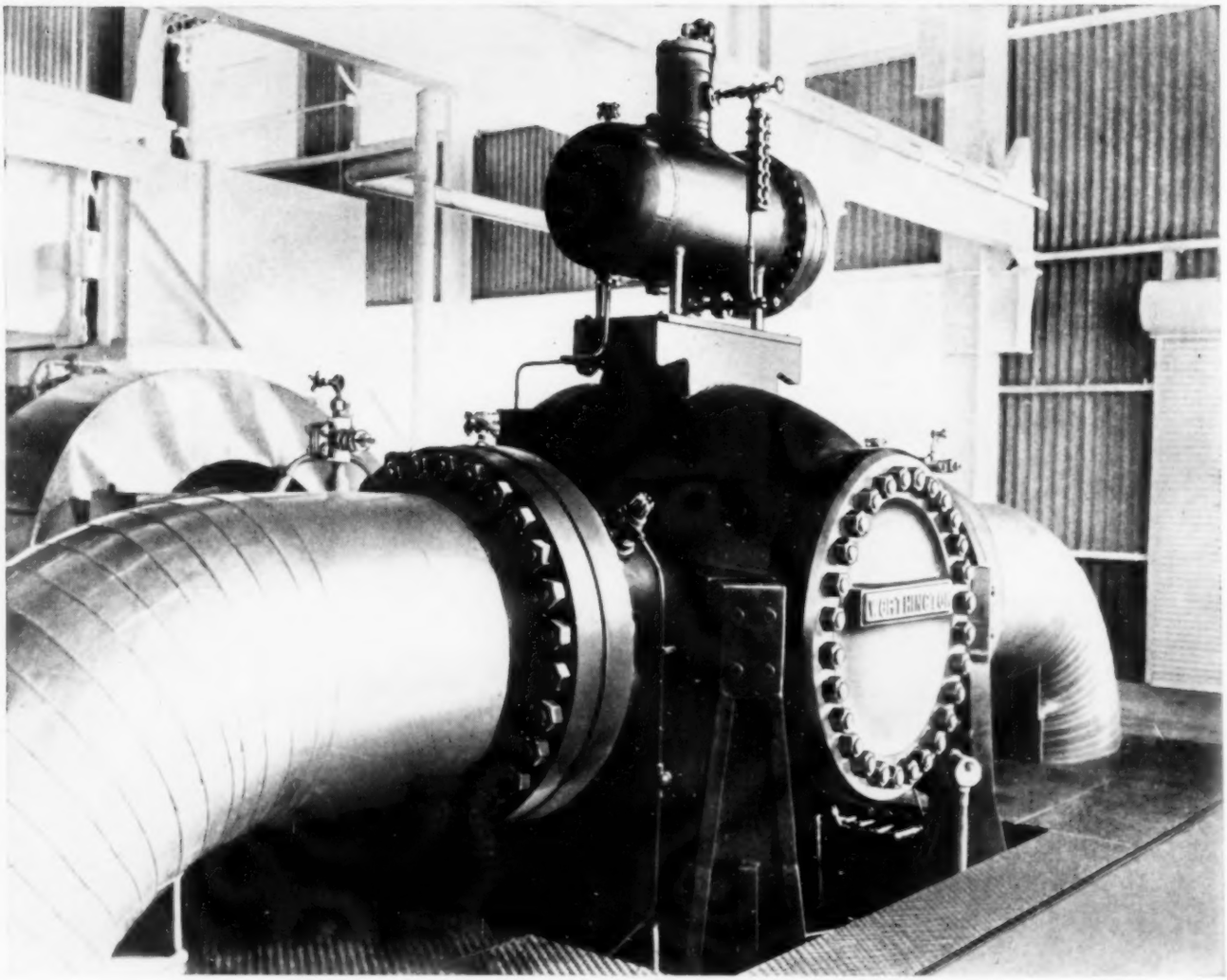
INTERNATIONAL HARVESTER

INTERNATIONAL®

International-Superior®

International Harvester Company, 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Pipe-Boom Tractors . . . Self-Propelled Scrapers and Bottom-Dumps . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Trucks . . . Diesel and Carbureted Engines . . . Motor Trucks



First "Center Line" Centrifugal Booster completes 18 months of pipeline service

Records show "practically no maintenance required"

This "new design" gas pipeline compressor has more than lived up to its advance billing. In service at Northern Natural Gas Company's Macksville, Kansas, station, since December, 1954, it has averaged 800 million cubic feet per day at a pressure of 500 psi. Records show that it has required practically no maintenance.

A brand new idea in compressor design, Worthington's type GUP compressor has a spherical casing supported at the center line. As a result, shaft distortions are minimized, starting stresses reduced, and bearing life extended.

A separate compressor driven pump supplies oil pressure at all times. By adding a cooler, the system may be made completely independent of the driver. A double trap in the scavenging system insures that no seal oil will seep into the gas stream.

It's easy to inspect. No internal part is too heavy for one man. The lightweight impeller, for example, weighs only 100 lbs.

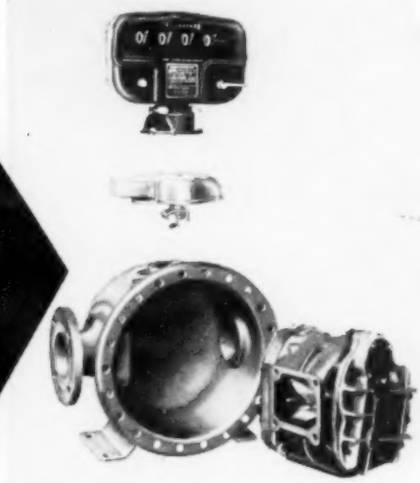
If you'd like more information about this new pipeline compressor, write for bulletin C-1100-B57 to Section E66, Worthington Corporation, Harrison, N. J. In Canada: Worthington (Canada) 1955, Ltd., Toronto, Ontario. E.6.6.

WORTHINGTON

you have greatest ACCESSIBILITY

for cleaning or inspection...

JUST FOUR UNIT-BUILT ASSEMBLIES



—of BRODIE *BiRotor* METERS

this means

- Continuing low maintenance cost
- Less wear and less repair
- Readily replaceable assemblies
- Reduced downtime and equipment tie-ups
- High maintained accuracy
- Continuous dependable performance

Simple, rugged, compact unit-built assemblies permit ready accessibility for inspection, cleaning, servicing—or replacement which is seldom required. Maintenance and service costs are reduced to a minimum. Just two moving parts with no metal to metal contact assures less wear—less repair and contributes to high sustained accuracy. For high metering efficiency at low cost standardize on Brodie BiRotor Meters. Investigate fully today.

WHAT COULD BE SIMPLER

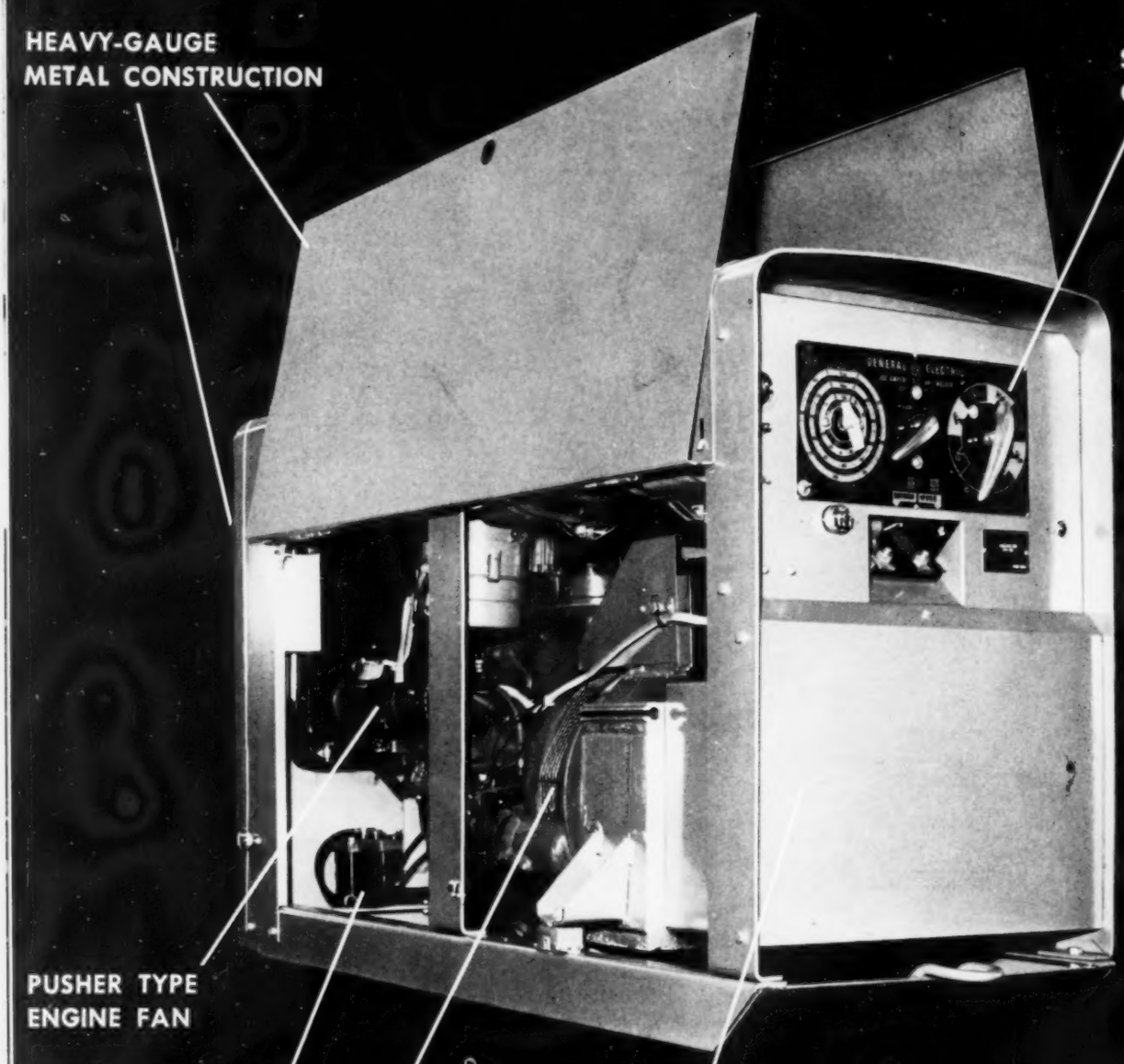
If cleaning or inspection is necessary, the simple unit-built assemblies can be readily reached without disturbing line connections!

BRODIE ALL-STEEL BiRotor TRUE-ROTARY METERS

RALPH N. BRODIE COMPANY · San Leandro, California, U.S.A.

MT. VERNON, N. Y. 550 So. Columbus Ave. | DALLAS 2, TEXAS 167 Parkhouse St. | CHICAGO OFFICE: 1227 Circle Ave., Forest Park, Ill. | SEATTLE 9, WASH. 221 9th Ave. N. | LOS ANGELES 22, CALIF. 5401 E. Sheila Street

REPRESENTATIVES WITH STOCKS AND SERVICE FACILITIES IN ALL PRINCIPAL CITIES



NOW—AVAILABLE IN 200-, 300-, 400-AMP MODELS

Prove it to yourself— Make this actual feature-by-feature comparison of General Electric engine-driven welders with two other lines of engine-driven welders. You will see that only the new G-E welders have so many advanced design features for better welding at lower cost.

EASILY PRESET Electrode Selector, Current Dial—Dual controls make current setting easier and more accurate.

GENERAL ELECTRIC	✓
MANUFACTURER A	
MANUFACTURER B	

How General Electric's NEW Line of Engine-driven Welders Can Help You Meet Contract Deadlines

Advanced design assures less "downtime," minimum maintenance—for faster, lower-cost welding

Nothing stretches out construction time more than unreliable or obsolete equipment. Such equipment increases your maintenance costs and results in nonproductive "downtime." It may even lead to contract fines and loss of repeat business.

To reduce construction delays, General Electric's new line of engine-driven welders has been designed and field-tested for maximum durability and minimum maintenance—without sacrifice in performance. These new 200-, 300-, and 400-amp welders save for you with the following advantages:

SAVE YOU TIME—Sturdy construction, the dependable Hercules engine, new-design generator, and simplified control all combine to give you steady output, longer operating time between overhauls, and reduced maintenance. This means more production per machine . . . per man-hour.

SAVE YOU MONEY—General Electric engine-driven welders begin saving you money the first day on the job. For example, the deep-sump crankcase provides complete lubrication to all moving engine parts—up to a 15-degree tilt in any direction. This helps to reduce costly breakdowns. And the over-all advanced design assures you of more and better welds at less cost, with a reduction in costly downtime for maintenance and repair. Additional General Electric advantages are described below.

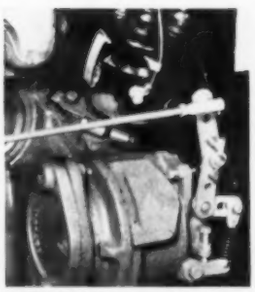
For more information about how General Electric engine-driven welders can help you, contact your nearby General Electric Welding Distributor. He is listed in the yellow pages of your telephone book. Write for descriptive bulletin to Section 714-5, General Electric Company, Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

CONSTANT-PRESSURE Brush Springs—Right pressure maintained for life of generator brushes without adjustment.

PRELUBRICATED Generator Bearings—Ball bearings prelubricated with sufficient grease for years of service.



DEPENDABLE Geared Governor—Gear-driven governor maintains close speed regulation for best welding.

PUSHER-TYPE Engine Fan—Large diameter pusher-type fan circulates ample cooling air for engine and generator.

CONTROLLED CURRENT Peaks—Current peaks are controlled. Arc can be crowded with no "stumbling" or "freezing."

	✓	✓	✓	✓	✓
		✓	✓	✓	
				✓	

MAN! Do we have connections!

Whether it is for automobiles, swim suits or natural gas, the major markets are where the most people are. Transco distributes natural gas to more than sixty distributing companies, serving many millions of people from Alabama to New York.

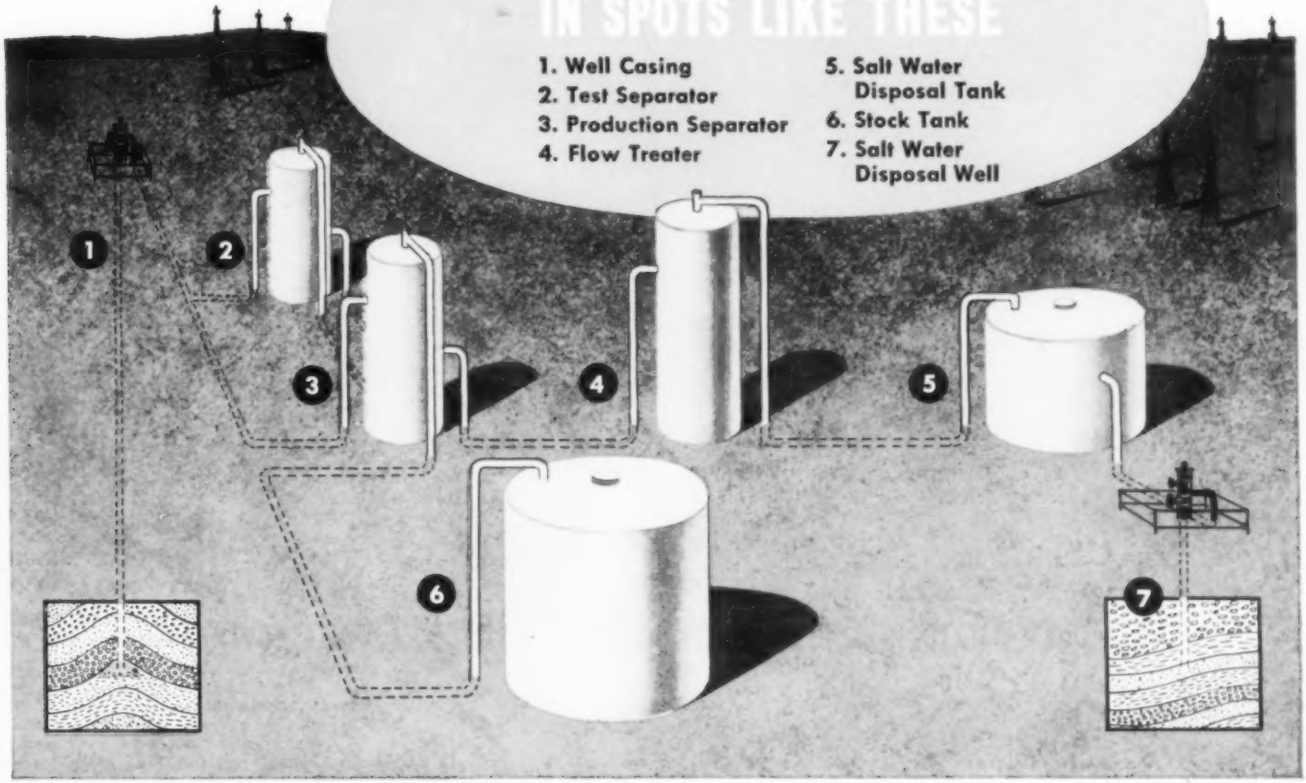
Producers of natural gas can have confidence in the steady demand of these major markets — in which we presently have an impressive number of connections and are constantly working to increase them!

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

HELPING TO EXPAND THE MARKETS FOR TEXAS-LOUISIANA NATURAL GAS

HOW TO PREVENT *Crude Oil Corrosion*

IN SPOTS LIKE THESE



...WITH TARSET®

HERE'S an important new weapon for controlling costly crude oil corrosion. It's TARSET—the effective new *coal tar-epoxy resin* coating. In test after test, Tarset has proved that it can stop corrosion caused by sour crude in storage tanks and in a growing number of other pieces of crude oil handling equipment.

Tarset is the toughest, hardest coating of its kind ever produced from coal tar. It will not shatter at −30°F. or soften at 400°F. It is superior to all other coal tar coatings in its ability to adhere to metal and concrete. And Tarset is easy to apply by brush, roller or spray.

If you have a corrosion problem—above ground or below—call on *Pittsburgh*. Without obligation, our engineers will gladly tackle your specific crude oil corrosion problem . . . and come up with dollar-saving answers. Let us hear from you today.

Send for Descriptive Booklet on TARSET today

Free booklet tells how to use amazing new Tarset to reduce costly corrosion. Gives detailed description of Tarset's specifications, properties and application characteristics. Write for *your* copy today!

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

NO FOG *with Rochester*

Hermetically Sealed Dial Instruments

Moisture, when permitted inside an instrument dial, not only fogs the dial glass but has destructive access to vital working parts inside. In addition to hard-to-read instruments, it leads to undependable performance and shorter, costlier instrument life.

Rochester Manufacturing Company developed its own hermetic dial-sealing process to completely eliminate this moisture hazard. The RMC process insures that humid air will not be sealed in the instrument and locks moisture out *permanently*.

Look to RMC for Full-Line Instrumentation

LEVEL GAUGES

Illustrated is an 8" dial, float-operated level gauge, with magnetically driven pointer, for pressure vessels. What is your liquid level gauge problem?

PRESSURE GAUGES

Illustrated is a heavy-duty compound type gauge for service on high frequency, low amplitude vibration. What is your pressure or vacuum gauge problem?

TELL US YOUR REQUIREMENTS FOR DIRECT MOUNTING AND REMOTE INDICATING INSTRUMENTS, AND LET RMC ENGINEERING SKILL PROVIDE THE ANSWERS!

Write today, outlining your particular need or problem.

RMC

"You Can Rely On Rochester"

REPRESENTATIVES IN ALL PRINCIPAL CITIES

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

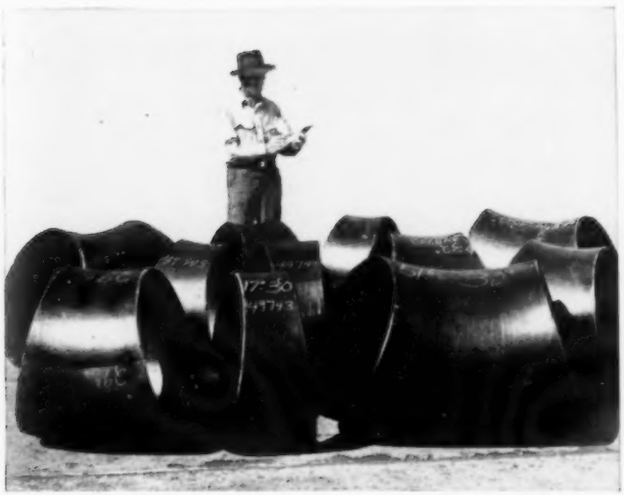
ROCHESTER MANUFACTURING CO., INC.

207 ROCKWOOD STREET • ROCHESTER 10, N.Y.

Speed up the job with

TUBE-TURN®

welding fittings and flanges



ANY ANGLE! Tube Turns can supply you with pipe line elbows not only in 45° and 90° types but in odd angles . . sizes as large as 42". Specify TUBE-TURN® Welding Fittings and save valuable time in the field.

COST REDUCERS. On Transcontinental line, TUBE-TURN Venturi Reducers minimize cost of valves and scraper traps. Reducers shown are 36" x 30" Courtesy Transcontinental Gas Pipe Line Corporation.

SIMPLIFIES CONSTRUCTION. You can get TUBE-TURN Manifold Welding Fittings with size, wall thickness and number of outlets as required by your job. Reduces costs for many types of service. Easy to install.

FOR "HOT TAPS." Strong, safe "hot tap" connections are made possible by the TUBE-TURN Full Encirclement Saddle. Fully meets all requirements for reinforcement of welded branch connections.

TUBE-TURN Welding Fittings and Flanges are made in U.S.A.
They meet all U.S. piping code specifications

"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

TUBE TURNS

LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Detroit • Chicago • Kansas City • Denver
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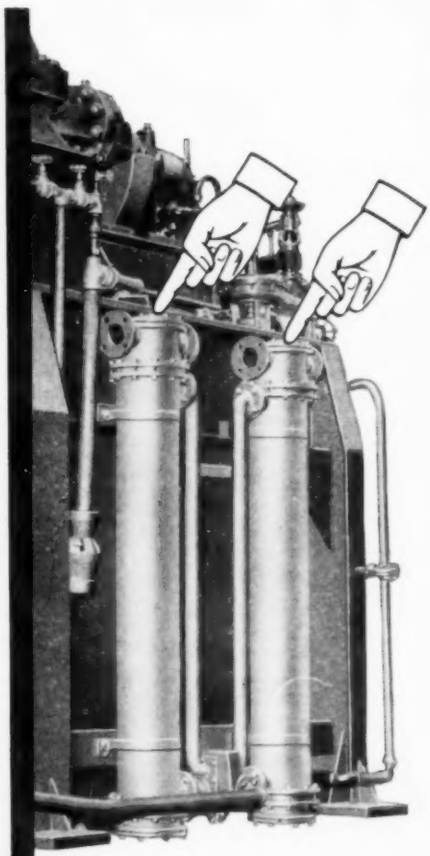
Ross Exchangers with I-R Compressor Trio moving 465,000,000 cu. ft. of gas per day

Boosting intake pressure from 470 psig to full line pressure of 800 psig, a series of three Ingersoll-Rand Steam Turbine Driven Centrifugal Compressors moves 465,000,000 cu. ft. of gas per day through this pipeline station. Because each of these I-R units is equipped with Ross Twin CP Exchangers, there are no lubrication temperature problems. Bearings and other vital turbine parts receive an ample supply of properly cooled oil at all times.

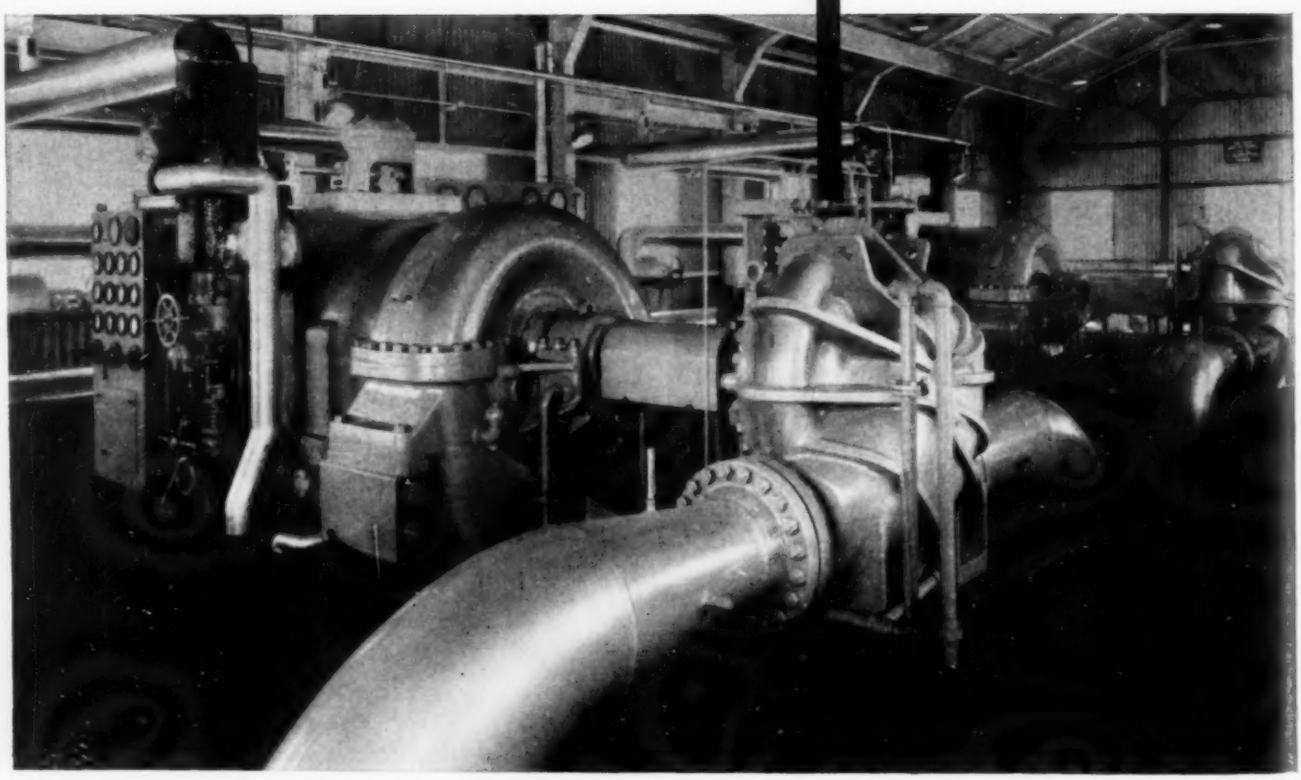
Unexcelled in thermal efficiency and ruggedness, Ross Exchangers are daily serving numerous types and makes of engines, compressors and other prime equipment on the oil and gas industry's most demanding jobs . . . under the most severe operating conditions.

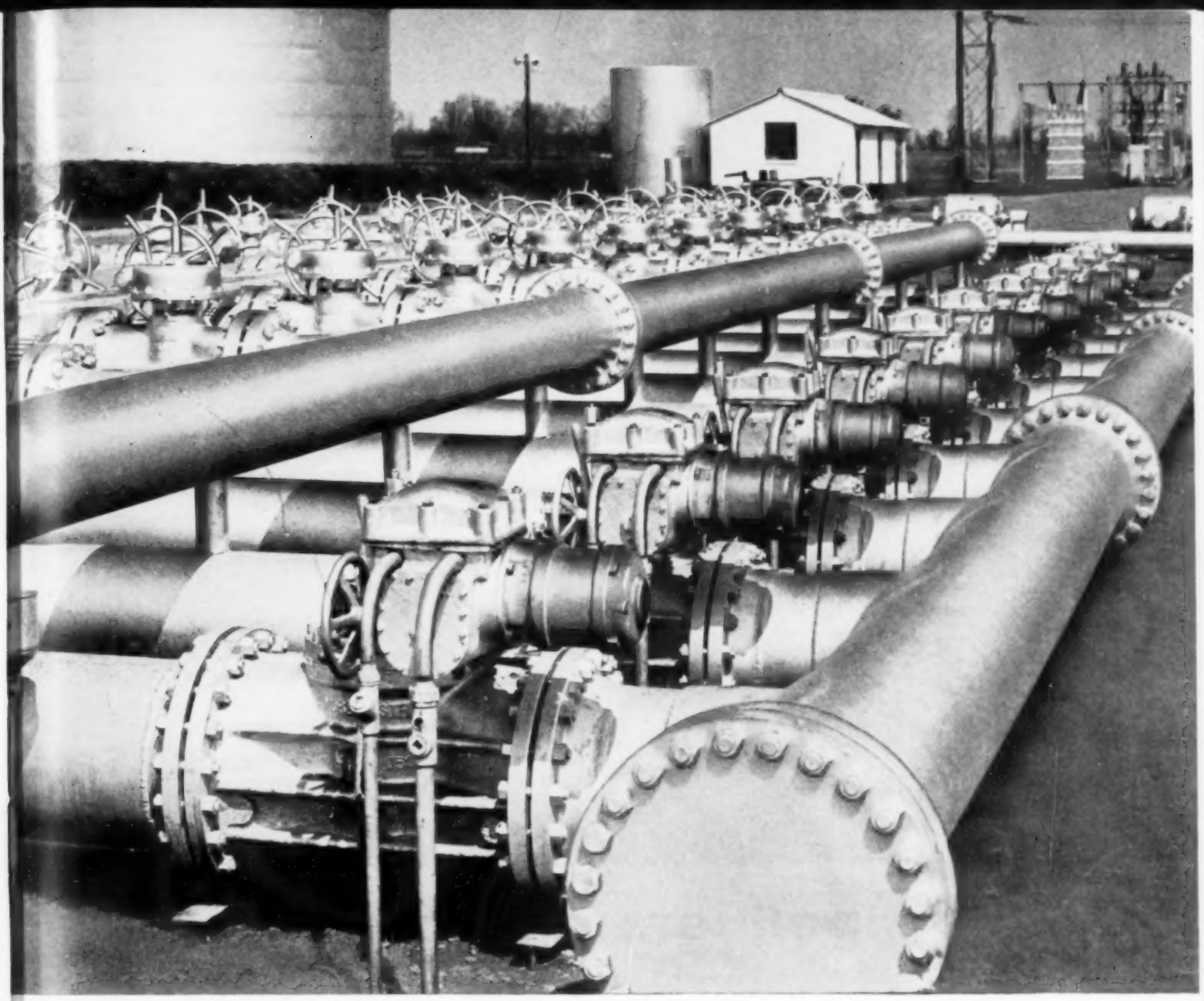
Compact in design, they're pre-engineered and fully standardized in sizes to meet a wide range of oil, water, air and gas cooling requirements. For detailed information, request Bulletins 2.1K5 and 1.1K5. Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.



ROSS

ROSS HEAT EXCHANGER PRODUCTS





ROCKWELL-Nordstrom VALVES

close faster, easier and stay tight!

Naturally the faster and easier a valve closes, the simpler and less costly its power mechanism can be. In Rockwell-Nordstrom valves the actuator only has to move the tapered lubricated plug through a quarter-turn for full opening or closure. The Seal-dport* lubricant system serves as millions of tiny bearings to greatly reduce torque. And it serves the extra purpose of sealing the seating surfaces bottle-tight. Compare this to the many turns required to close ordinary valves and the excessive torque necessary to wedge-in the seats. It's easy to see why Rockwell-Nordstrom valves have proven to be the most reliable valves for automatic pipe line control.

Rockwell-Nordstrom valves are available in a complete range of sizes from ½" to 30" and in pressure ratings from 175 to 1440 lbs. for electric, cylinder and pneumatic operation. Write today for Bulletin V-214, "Power Operated Rockwell-Nordstrom Valves." Rockwell Manufacturing Company, Pittsburgh 8, Pa. *Canadian Valve Licensee:* Peacock Brothers Limited.

**Registered trade mark Rockwell Manufacturing Company*

ROCKWELL-Nordstrom VALVES

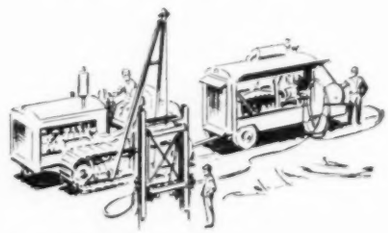
Lubricant Sealed for Positive Shut-off

40th YEAR *of lubricated plug valve leadership*

Why pipeliners on-the-go go for the I-R DUAL-DRILL RIG

HERE'S A fast-drilling, fast-moving outfit that's geared to the needs of modern pipeline construction. The Dual-Drill Rig, mounting a pair of X71-WD Rock Drills sinks two holes at a time — can be swiveled to provide any desired hole spacing or trenching pattern. All controls, for power feed, hammer action and hole cleaning, are right at the operator's fingertips.

Used with faster-drilling, longer-lasting CARSET JACKBITS and powered by a dependable, maintenance-free GYRO-FLO 600 rotary compressor, the Dual-Drill Rig has repeatedly proved its ability to deliver maximum footage per shift per man and lowest possible cost per foot of trench. It will pay you to get the whole story from your I-R representative — the sooner the better.



- **I-R DUAL-DRILL RIG**
- **I-R CARSET JACKBITS**
- **I-R GYRO-FLO 600 COMPRESSOR**

...a pace-setting team for modern pipeline construction

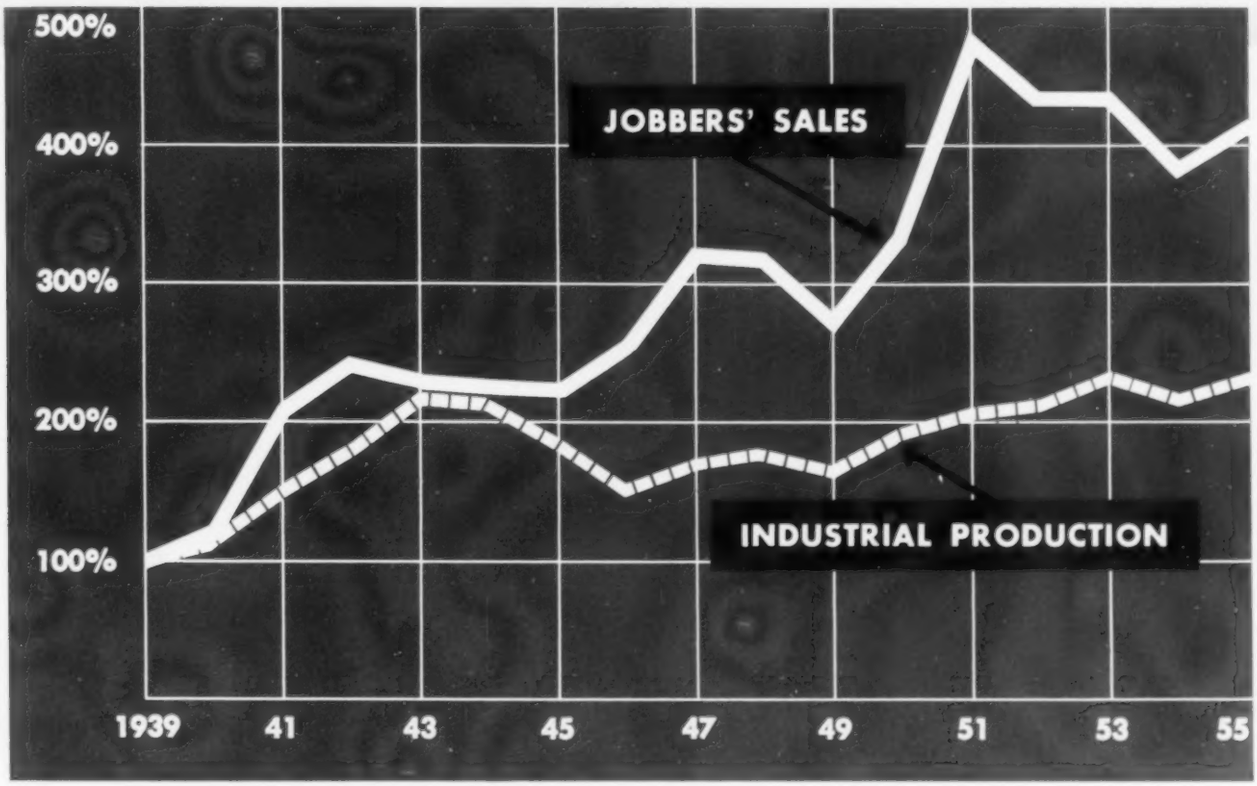
Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

5-384

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

JOBBERS Prevent Hardening of the ECONOMIC ARTERIES

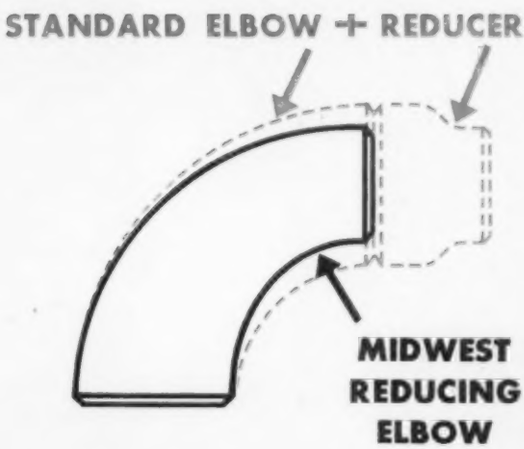


The chart above shows that the jobber is now handling a larger share of industrial goods than ever before. Users are finding it to their advantage to look to him for more of their needs. The jobber reduces the user's inventory, assures prompt delivery, provides technical assistance when needed . . . and many other benefits. Are you using him to your own best advantage?

MIDWEST

Jobbers Save You Money, Time and Trouble on Welding Fittings

Midwest Jobbers have the most complete line of welding fittings . . . which often permits them to improve or simplify piping. Only Midwest jobbers offer you a full size range of reducing elbows that take the place of two fittings . . . a straight elbow and a reducer, thus saving space and one weld. There are many other advantages to be gained by using Midwest Welding Fittings . . . see for yourself . . . ask for Catalog 54.



MIDWEST
PIPING COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.

Plants: St. Louis, Clifton, N.J. and Los Angeles

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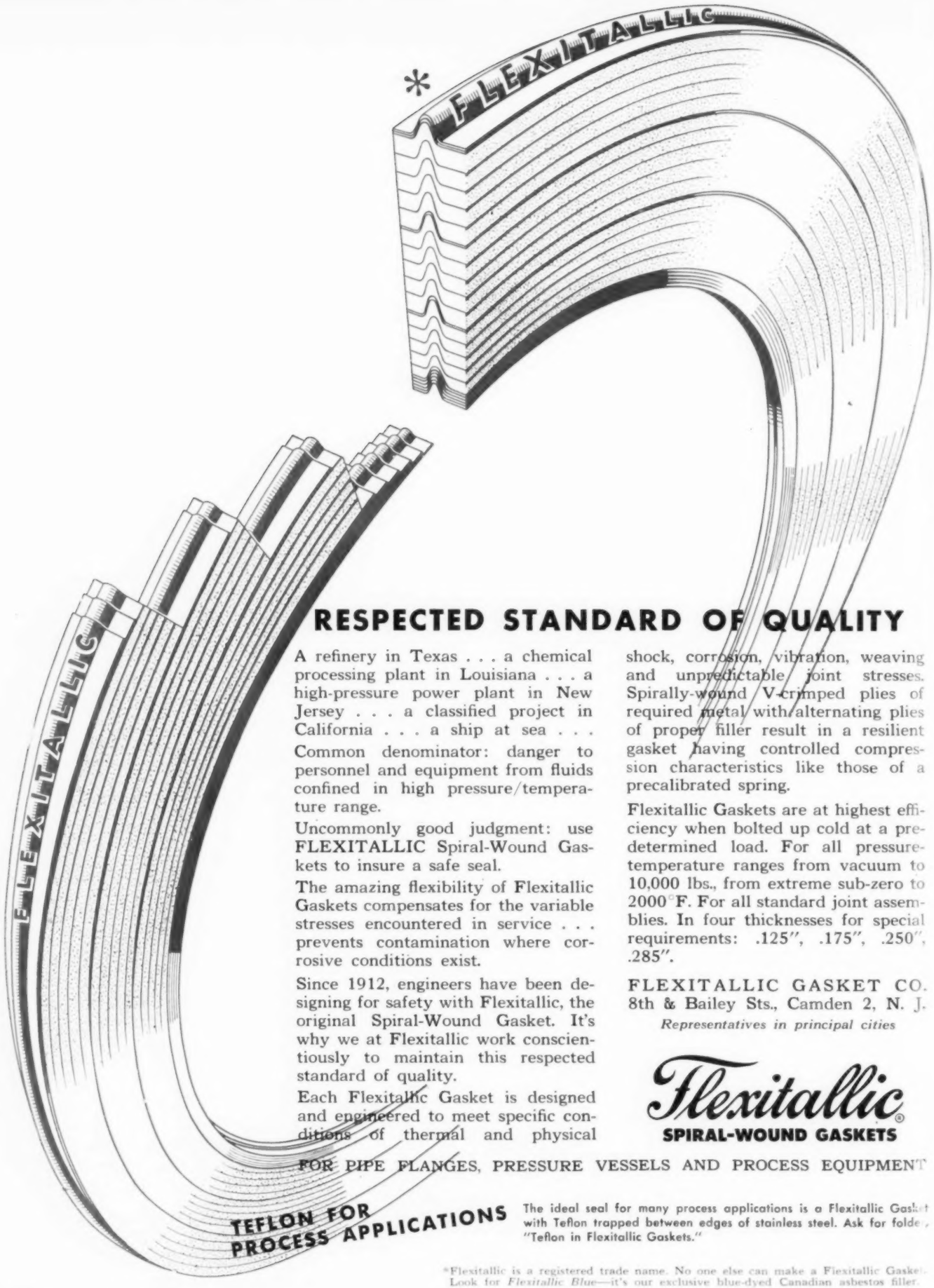


RESPECTED STANDARD OF QUALITY

A refinery in Texas . . . a chemical processing plant in Louisiana . . . a high-pressure power plant in New Jersey . . . a classified project in California . . . a ship at sea . . .

Common denominator: danger to personnel and equipment from fluids confined in high pressure/temperature range.

Uncommonly good judgment: use FLEXITALLIC Spiral-Wound Gaskets to insure a safe seal.

The amazing flexibility of Flexitallic Gaskets compensates for the variable stresses encountered in service . . . prevents contamination where corrosive conditions exist.

Since 1912, engineers have been designing for safety with Flexitallic, the original Spiral-Wound Gasket. It's why we at Flexitallic work conscientiously to maintain this respected standard of quality.

Each Flexitallic Gasket is designed and engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having controlled compression characteristics like those of a precalibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure-temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285".

FLEXITALLIC GASKET CO.
8th & Bailey Sts., Camden 2, N. J.
Representatives in principal cities

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

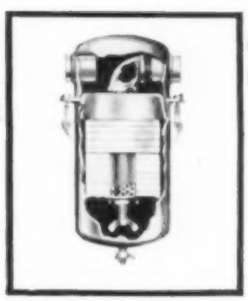
TEFLON FOR PROCESS APPLICATIONS

The ideal seal for many process applications is a Flexitallic Gasket with Teflon trapped between edges of stainless steel. Ask for folder "Teflon in Flexitallic Gaskets."

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

KEEP IT CLEAN...

by Phil Tration



MODEL AAPHS ABSORPTION FILTER

To say that *every* pipe line needs a Dollinger filter is certainly an exaggeration. However, if you want to protect air-operated equipment from damage caused by moisture and other foreign matter a *Dollinger Absorption Filter* is just the thing.

Illustrated at right is the *Model AAPHS*, which is used by thousands of manufacturers from coast to coast to eliminate process shut-downs and save thousands of dollars annually.

Why take chances with water that can rust and clog your equipment, ruin your work, or shut down processes. The unique design of Dollinger Absorption Filters eliminates every trace of moisture in air lines.

Write, wire, or call today for complete facts. Ask for Bulletin 200. Dollinger Corporation, 95 Centre Park, Rochester 3, N. Y.

DOLLINGER
STAYNEW FILTERS

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS
ELECTROSTATIC FILTERS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS
VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS
AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

Cut maintenance costs. . . increase pipe life

with proven performance . . .

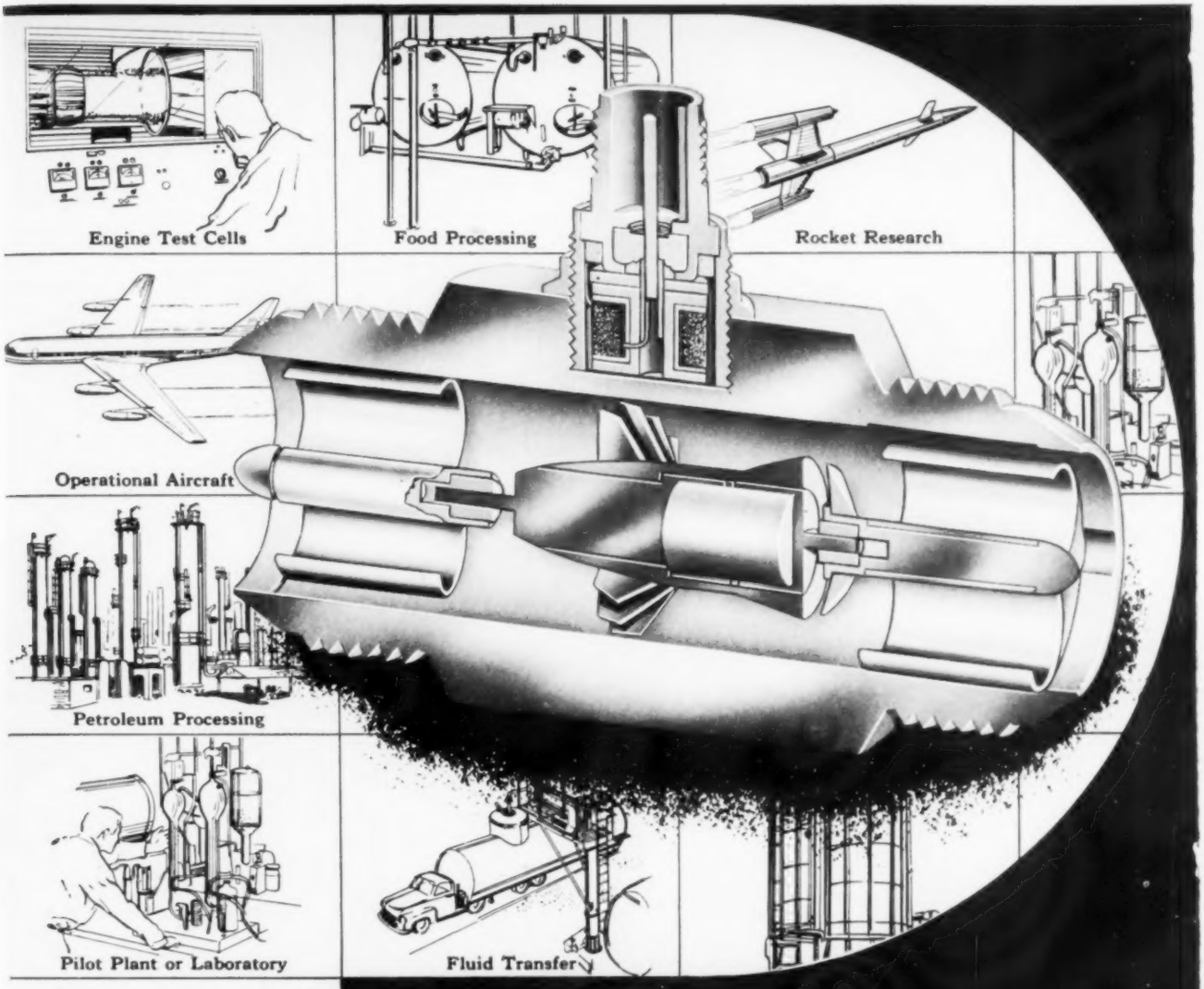
On job after job, pipe line men rely on these Johns-Manville Asbestos Pipe Protection Materials to fight pipe line corrosion:

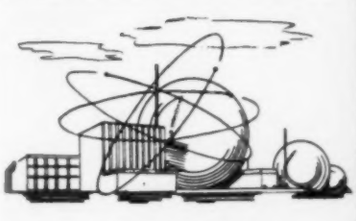
Transhield® Asbestos Felt This low-cost pipe line protecting wrapper is specially designed to increase pipe life under average soil conditions. It is reinforced with continuous glass yarns, parallel spaced on ¼″ centers to give tear-free application strength. Made of coal-tar saturated asbestos, it acts as a lasting barrier to shield pipe line enamels from earth loads and soil stresses.

#15 Asbestos Pipe Line Felt—A heavy-duty material particularly suitable for severe soil conditions or where a heavier material than J-M Transhield is desired. Provides long life, toughness, flexibility, resistance to rot, decay, cracking, and impact. J-M #15 Asbestos Felt now protects more than 100,000 miles of oil and gas pipe lines. Widths 2″ to 36″. Rolls any length desired.

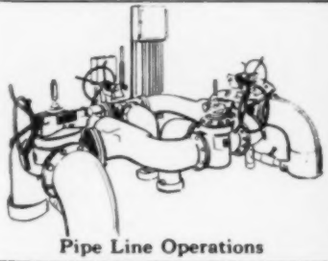
For further information about Johns-Manville Products for Pipe Line Protection, write to Johns-Manville, Box 14, New York 16, N. Y.; in Canada, Port Credit, Ontario.

JOHNS MANVILLE JM PRODUCTS **Johns-Manville** **PRODUCTS FOR PIPE LINE PROTECTION**





Nuclear Power



Pipe Line Operations

Process Control

POTTERMETERS

Complete flow control systems

In every industry where liquid flow information is required, Pottermeters have set new standards of accuracy and reliability.

The only "bearingless" flow meter, the Pottermeter is unaffected by caustics, acids, corrosives and completely reliable even under extreme conditions of temperature and pressure.

Potter engineering has solved many "impossible" flow control problems. Maybe we can help you.

POTTER AERONAUTICAL COMPANY

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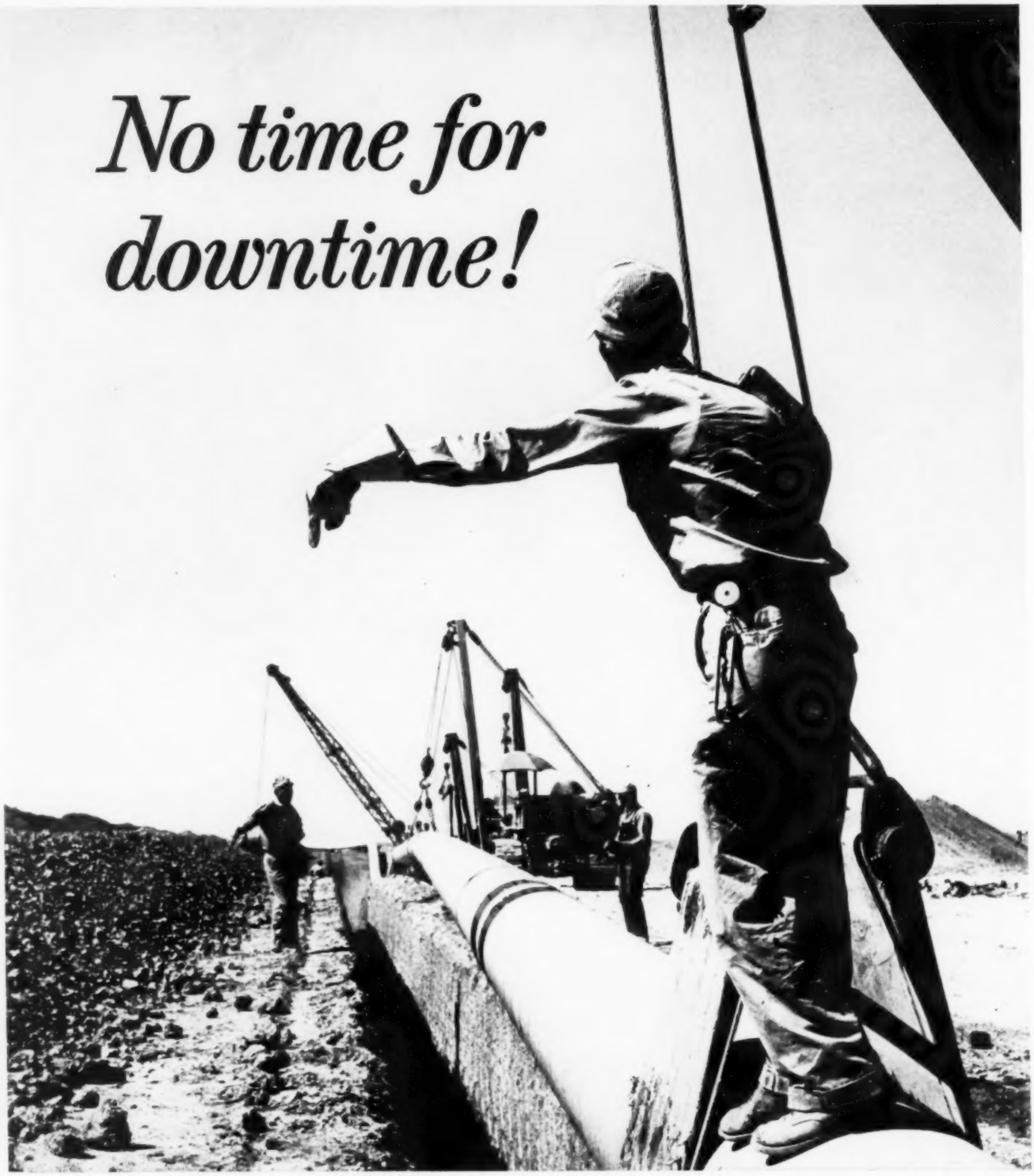

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PIPE LINE PANORAMA

Oil May By-Pass Suez . . . Nasser's folly may speed project to pipe Middle East Crude to Eastern Mediterranean. High on priority list is 1200 mile, 38-40 inch line beginning in Kuwait, passing through Basra area of Iraq, up Tigris Valley through Mosul area to southeastern Turkey, and continuing westward through Turkey to Mediterranean port of Ikenderun.

Expected cost: $500 million. Time to build: Five years.

Trans-Europe Pipe Line? . . . If Royal Dutch Shell's dream comes true, Middle East oil might one day by-pass Suez all the way to North Sea. In discussion stage is plan to build 30-inch, 700-mile crude pipe line from Marseilles on the Mediterranean to Rotterdam and Antwerp on the North Sea. Estimated cost: $280 million.

Reasons for proposed line: (1) Europe's oil consumption is expected to jut upward in next 20 years and better oil transportation service will be needed to fuel industry in France, Germany, Luxembourg, Holland and Belgium; (2) would allow refineries to be located closer to major markets, rather than at ports; (3) would permit considerable savings in deployment of tankers bringing crude from Middle East to European markets—particularly if Kuwait-Turkey pipe line is completed.

Work Progresses on Trans-Canada . . . Construction on 30-inch, 2250-mile Trans-Canada pipe line is progressing as fast as steel deliveries will permit. Trans-Canada officials, although admitting steel strike has slowed down pipe deliveries, emphatically deny stating that gas will not be available through line until next summer.

Signs of the Times . . . El Paso Natural will increase its pipe line capacity 36.5 percent from present 2.05 billion cubic feet a day to 2.8 billion cubic feet.

Length of project: Three years. Cost: $360 million. About 2 billion cubic feet of new capacity will be sold in California.

American Louisiana's $16 million program to increase its Midwest delivery capacity from 300,000 Mcf/d to 400,000 Mcf/d has received at least a temporary green light from FPC. Commission has given tentative approval for $8.6 million project to build two new 12,000-hp stations and add 2000 hp to two of American Louisiana's present stations, thus boosting delivery capacity 60,000 Mcf/d.

Oil Pipe Lines Show Gains . . . Interstate Commerce Commission reports oil pipe line revenues up 8.9 percent to $163.9 million in second quarter. Traffic was up 9.6 percent over second quarter in 1955 to 1.05 billion barrels of oil. Sixty-seven pipe line companies are listed in the report.

Gas Pipe Line Business Up in June . . . Natural gas pipe line companies report healthy increases for June. Operating revenues were up 13.7 percent over June, 1955 to $152 million. Clouding the rosy picture a bit, operating expenses were up 16 percent to $98.6 million. However, net income was up 12.9 percent to $16.2 million.

Milk Via Pipe Line . . . The Swiss have come up with novel idea to solve age-old problem of trying to get milk from mountain pastures to lower dairies.

Solution: Plastic pipe line will be tested for carrying milk during months when herds graze in the mountains.

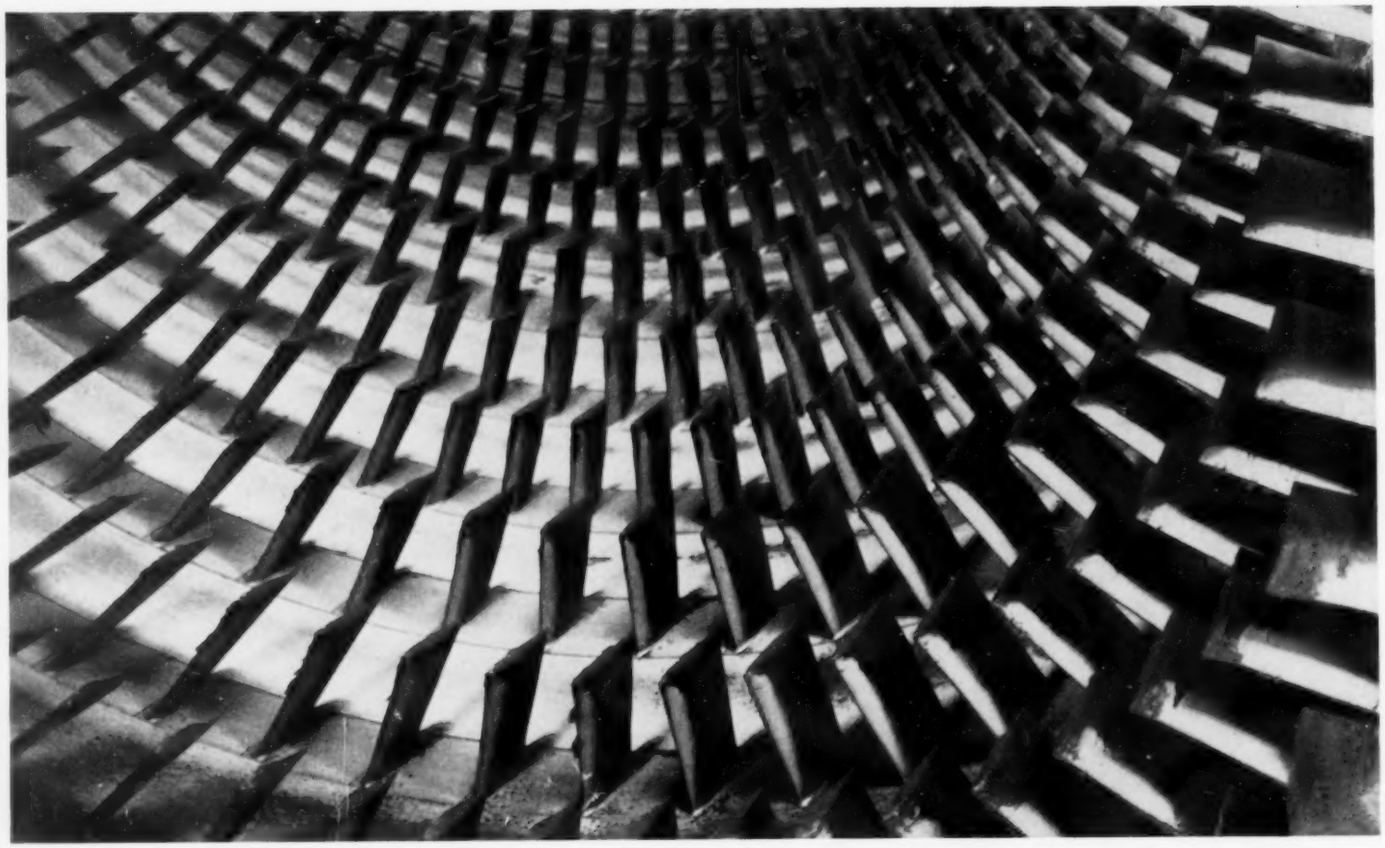


FIGURE 1—Fouling of axial-flow compressor stator with water-soluble solids was a peculiar problem El Paso encountered when water particles were carried over from intake air washers. To control it, washers now are used only when relative humidity is below 50 percent and ambient temperature is above 50° F.

El Paso's Repairmen Keep Turbines on Line

Engineers and maintenance men at El Paso Natural Gas Company's ten gas turbine compressor stations met special conditions with equipment modifications. Now, with shakedown behind them, they look forward to high performance and low cost operations.

By A. H. CARAMEROS, El Paso Natural Gas Company, El Paso

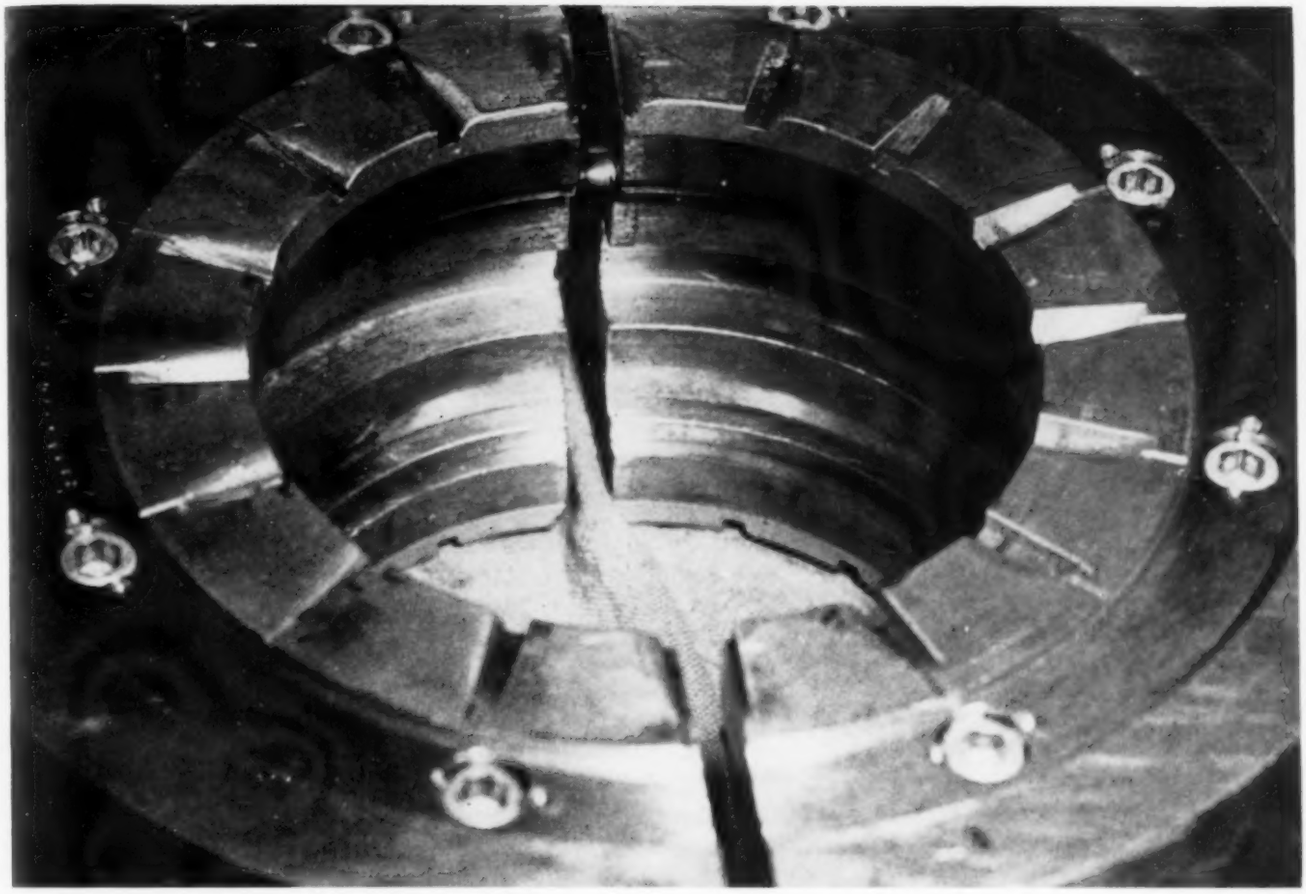
ADAPTING EQUIPMENT to new applications with unusual conditions and personnel who are not familiar with it always presents some unexpected problems. Installing and operating 28 gas turbines on the El Paso Natural Gas Company system from September, 1952, to January, 1956, was no exception.

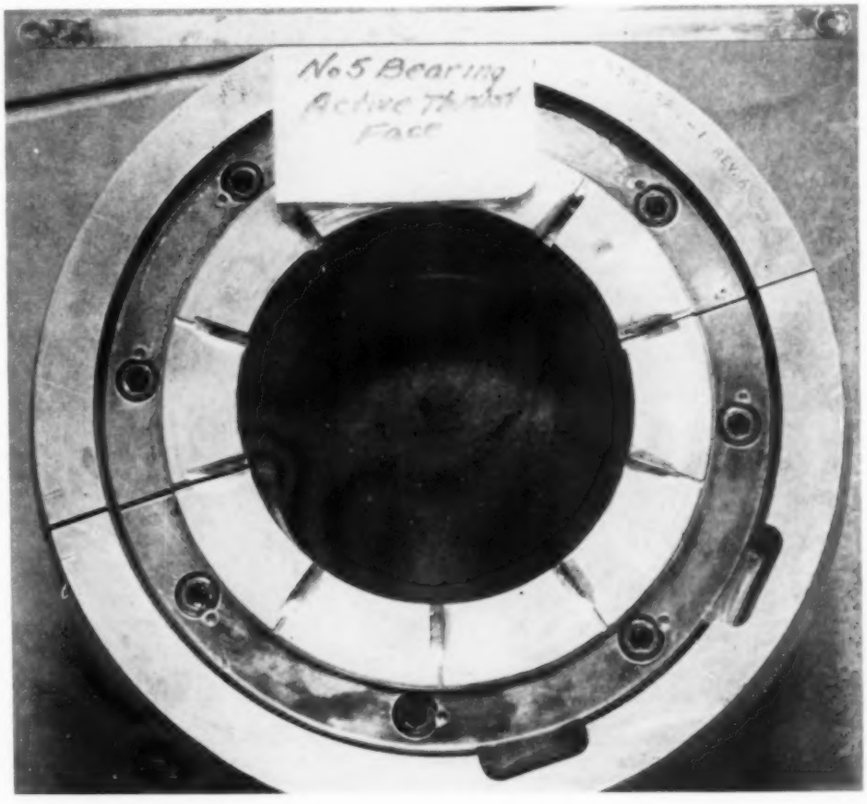
The first gas turbine was put into operation in September, 1952, to handle about 1.1 billion cubic feet of gas per day over a ratio of 1.13 at 600 pounds per square inch suction pressure. The centrifugal compressor required a prime mover rated at 5000 horsepower at 80° F. ambient and 1000 feet altitude.

El Paso's basic turbine station consists of three gas turbine-driven centrifugal compressors in series. Gas enters the station through two piston-operated block valves from two pipe lines, a 26-inch and a 30-inch. After being cleaned in three gas scrubbers it feeds into a single 30-inch line. It then passes through a 30-inch suction valve, is compressed and discharged through a 30-inch plug valve.

A 30-inch check valve across each compressor allows by-passing any unit not operating. There is a 2-inch motor valve across the suction to purge and pressurize the compressor. A 4-inch motor-operated valve on the suction side of the discharge valve is used for venting.

After compression, the gas is fed back into the main line through two





FIGURES 2A and 2B—Early failures of active thrust bearings on El Paso turbines led to strain gage measurements of impact load on the bearing lands. Tests showed that larger lands were needed to stand up on those turbines with high break-away speed. Modifying bearings to increase the area of the flat lands stopped the failures.

piston-operated block valves. The station may be by-passed by two 30-inch valves operated remotely.

El Paso's two-shaft regenerative-cycle gas turbine is coupled to the compressor by a floating flexible coupling, 42 inches long. Air is brought into the axial-flow compressor through an air washer to scrub and cool it. About 90 pounds of air per second is compressed through 14 stages and discharged into the regenerator at about 74 pounds per square inch absolute and 476° F. Compressed air is then preheated to 800° F. and fed into six combustion chambers where its temperature is raised to 1450° F. by burning natural gas.

Two-thirds of the available power in the gas is absorbed by the high pressure turbine which drives the axial flow compressor at 6900 rpm. About 5000 horsepower is absorbed by the load turbine at speeds varying from 4000 to 5500 rpm depending upon compressor load conditions. Exhaust gases flow to the regenerator at 880° F. where they heat compressed air. Stack temperature is 566° F.

The turbine is started by a small expansion turbine which uses 150 pound gas as a working fluid. This

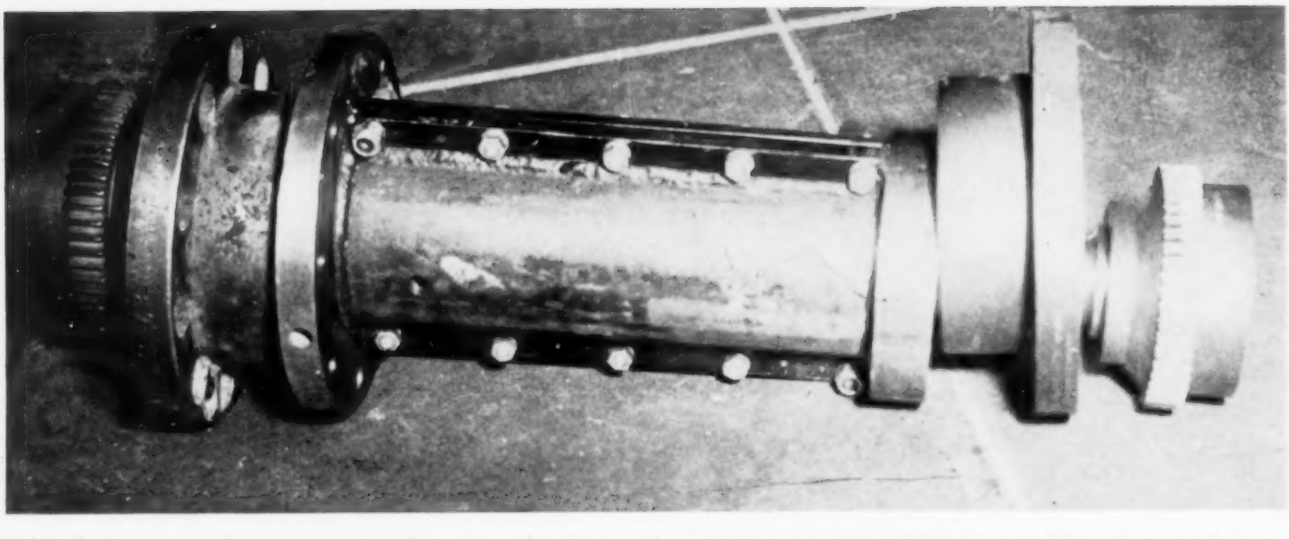


FIGURE 3—Excessive teeth wear occurred on the gear coupling between the axial flow compressor and the gear box. Adding O-ring seals stopped grease from slinging out at speeds from 2000 to 7000 rpm. Another possible solution considered—use of a continuously oil lubricated coupling

turbine is coupled to the axial-flow compressor by a clutch through a gear box which also permits power take-off to drive an AC generator and turbine auxiliaries. Starting is accomplished automatically by proper timing and sequence. Controls are push button operated.

Growing pains eased by equipment changes. As might be expected in any new engineering job of this size, several unexpected problems came up during initial operations. This is not a criticism of the design or manufacture of the equipment itself. It rather is a report of the growing pains and, more important, the solutions which now have been proved in actual pipe line operations.

Increasing land area corrected thrust bearing failures. In the early days of operation, rapidly occurring failures of the No. 5 active thrust bearing led to impact load measurements on this load-turbine thrust bearing with strain gages. Turbines which had the highest breakaway speed (that high pressure turbine speed reached when load turbine breaks away) had the highest incidence of this type of failure.

Strain gage studies of impact loads showed that larger flat lands were needed to carry the high static thrust. After this area was increased no more of these failures occurred.

Gear box bearing failures stopped by changing oil feed. Damage to the duplex bearings on the shafts of the right angle gears was detected before it extended beyond the bearings themselves. To correct the failures, the oil-feed system has been modified and more rigid specifications are made for replacement bearings. With the program nearly complete, there has been no evidence of damage on modified units.

As a precautionary step, one gear box unit was equipped with a sleeve bearing. It now has run over 3600 hours with no evidence of excessive wear or trouble.

O-ring seals stop gear box grease loss. In early operations a serious problem arose when the grease lubricated gear coupling between the axial flow compressor and the gear box started throwing grease at speeds from 2000 to 7000 rpm. Modifying the coupling with O-ring seals stopped the grease loss.

There may still be some lubrication difficulty here, certain greases tend to separate at high speeds. One good solution to this may be a continuously oil-lubricated coupling.

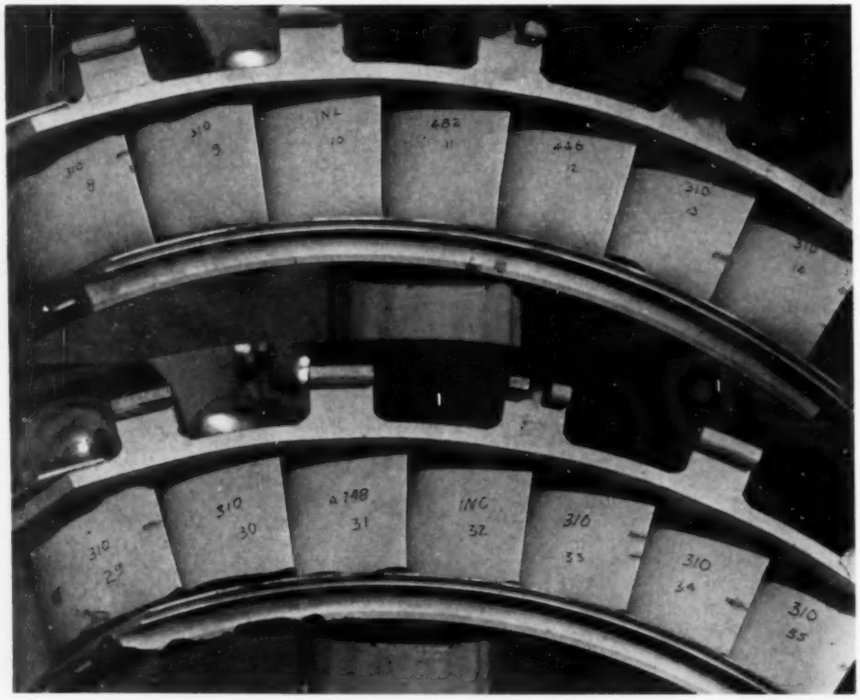


FIGURE 4—First major inspections of turbine stations disclosed small cracks in the trailing edges of the first stage nozzles. Service tests with various alloys showed that some of the stainless steels were subject to this defect where higher chrome-nickel alloys were not.

Alloy metallurgical tests eliminated cracks in first stage nozzles. In the first major inspection of gas turbine stations, slight cracks were detected in the trailing edge of the first stage nozzles. Immediately, a program was started to find out what type alloys would hold up longest in this service.

In an inspection of a later turbine, no cracks were evident; the nozzles were in excellent condition. Tests showed that two different type alloys were used. Tests on alloys shown in Table 1 disclosed the types of alloys which could give maximum trouble-free service life on the first stage nozzles. With these high performance alloys in service, the problem of cracks in nozzles has been greatly reduced.

TABLE 1

Test of Alloys Used in First Stage Nozzles

Material Specs.	Condition
Stainless Steel AISI Type 310	Cracked as shown in Fig. 4
Stainless Steel AISI Type 446 Sealmet Grade Special Heat Treat	No cracks or pitting
Nickel-Chromium Alloy—(22% Chromium, 34% Nickel) Special Heat Treat	Showed signs of pitting, see Figure 4
Nickel-Chromium Alloy—(Nickel 15.5% Chromium 8% -Fe)	Good condition
Vacuum Cast Ingot No. 482, 20% Chromium, 35% Nickel Special Heat Treat	Showed slight pitting, see Figure 4
Strengthened 27% Chromium Steel (A-748-K) Special Heat Treat	Good condition

Note:* Stainless Steel Type 321 and 314 have shown to give good service, but were not included in the above test.

Cracks at Christmas tree joints were ground out—wheel rebalanced. Small cracks have appeared in the high-pressure turbine wheel on three inspections. This problem is now being studied. Repair is simple. Cracks are ground out and the wheel is then rebalanced.

Expansion joints prevent cracks in regenerators. Of 28 tube-type regenerators installed at turbine stations, the first nine delivered did not have expansion joints. In these nine, cracks occurred in the ligaments of the tube sheet and in the weld between the tube sheet and shell.

Extent of damage seems dependent on the number of starts that each regenerator is subjected to after a complete cool down. Modification is planned for these units. Other regenerators have been inspected regularly and are in good condition.

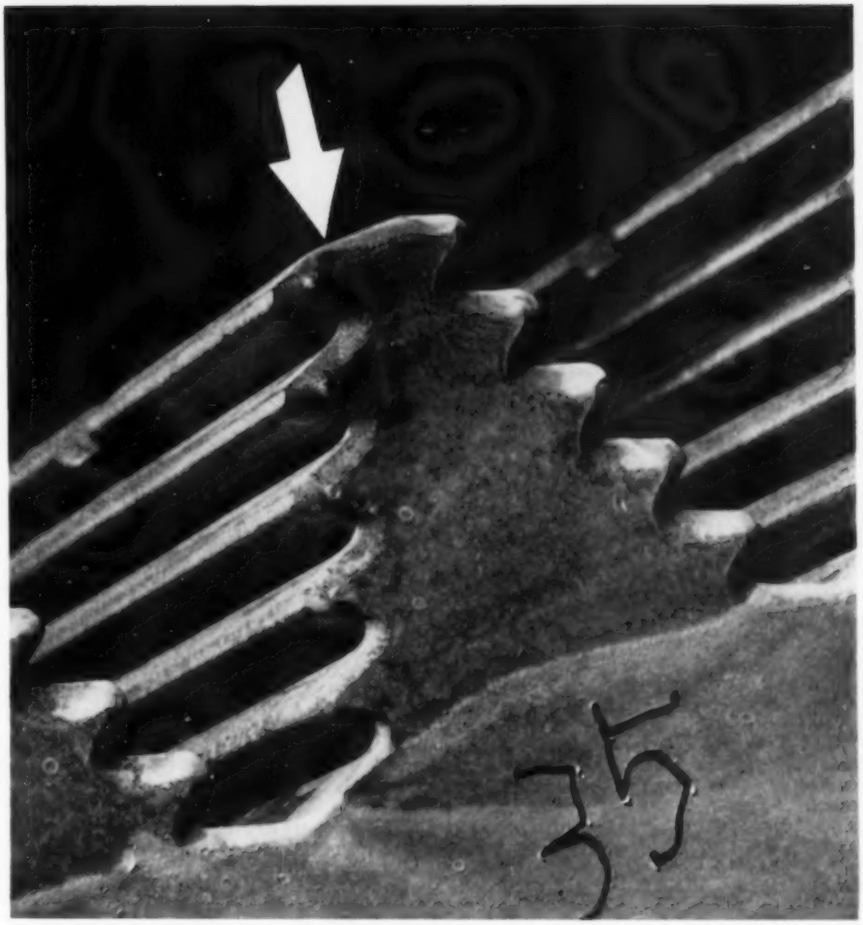


FIGURE 5—Cracks on the Christmas tree section of the first stage wheel were repaired simply. They were ground out and the wheel was rebalanced. El Paso engineers now are trying to determine cause of this damage.

FIGURE 6—Tube-type regenerators installed without expansion joints have cracked in the ligaments of the tube sheet. Modifications are planned for nine units. Those with expansion joints built-in are in good condition.

FIGURES 7A and 7B—Turbine bucket failures shown above can be costly in damage to other turbine parts, such as seriously damaged second stage buckets below. A detailed testing program carried out by the manufacturer and El Paso engineers points to start-up thermal shock as the cause. To stop it, firing temperatures are being limited to 1100° F. when cranking with 680° F. air. All buckets are being removed as operations permit for heat treatment and rounding of the leading edge to reduce stress concentrations.

Thermal shock effect reduced to stop bucket failures. Three nearly identical cases of bucket failures have occurred on El Paso's turbines. Equipment damage is both serious and expensive. Immediate steps were taken to find the cause.

One turbine was made available to the manufacturer for testing. Starting and steady state inlet temperatures were measured with a self-aspirating thermocouple to reduce errors caused by radiation. Steady state temperatures were found to be normal; however, initial starting temperatures as high as 1800° F. were measured. Tests indicated that the cause of these failures could well be thermal shock.

The starting sequence of turbines was modified to limit firing temperatures to 1100° F. when cranking with 680° F. air. As an additional precaution, all turbine buckets are being removed for heat treatment and radiusing of the leading edge.

Heat treatment will be used on buckets made of NA-80 material and both the NA-80 and S-816 buckets will be radiused on the leading edge to remove any thermal cracks which have been set by high starting temperatures. Modifications are now complete on three units could prevent future repair bills that might run as high as $45,000.

Compressor guide vane modified to prevent vibration damage. During inspection of one of the bucket failures, maintenance men noticed a cracked inlet guide vane blade on one of the turbines. Two other companies had experienced compressor failures and it was found that two or three inlet guide vane blades were missing.

Later tests showed that the inlet vane blades were in tune with the vibration stimulated by the first stage rotor blades at 6900 rpm. The solution was comparatively simple. Tips of the blades were given additional support by welding them to a circular band. This modification is being made along with the turbine bucket changes.

Compressor fouling controlled. El Paso turbine stations have this peculiar problem because air washers are used for both cleaning and cooling of inlet air. This gives the turbine additional horsepower, but also introduces

the possibility of fouling the axial-flow compressor with water-soluble solids should any spray be carried into the compressor.

To forestall this, washers are operated only when the relative humidity is below 50 percent and ambient temperature is above 50° F. Axial-flow compressors are cleaned every 10,000 to 15,000 hours depending upon dust conditions.

School set up to train station personnel. El Paso's turbine stations are manned by a chief operator, a repairman, five operators and one yardman. Shift work is carried out by four operators, except for one eight-hour shift handled by the senior operator. The senior operator devotes much of his time to minor station maintenance along with the repairman.

These men had to be trained to operate and maintain the 28 gas turbines at 10 stations, stretched out over 500 miles of pipe line. Preliminary training was accomplished by assigning operating personnel to the construction crews. Later, maintenance men and engineers visited each plant and gave courses to explain theory and operation of the turbines.

When the repairman was assigned to each station, the need for a full-fledged school was pointed out clearly. Ten repairmen were then brought in to El Paso for a four-weeks course covering each element of the turbine, its controls, accessories, and maintenance procedures and records.

Although the program was extensive, even more instruction would be worthwhile if the men could be spared from their regular work.

Roving crew handles major overhaul. Heavy mechanical maintenance and major inspections are handled by a roving crew of six men. This crew can complete a teardown and assembly in about 18 eight-hour days. El Paso turbine repair crews work ten days and are off four to allow them a maximum amount of time at home. One factory service engineer is available at each overhaul both for consulting and factory contacts.

An average major inspection costs about $10,000; they are anticipated every three years. Parts replacements have not yet become a factor in these costs since the maximum number of service hours on any turbine is only about 20,000.

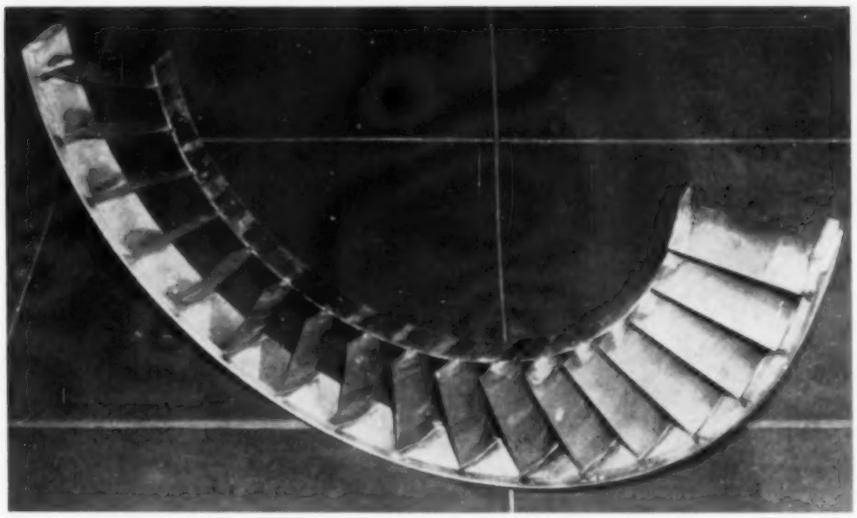


FIGURE 8—Cracking of inlet guide vane blades is prevented by tying the tips of the blades together by a supporting ring. This stops damage resulting from vibration stimulated by the first stage rotor blades which are in tune with the guide vane blades at a speed of 6900 rpm.

Fifteen turbines have been inspected. Major inspection time and cost could be reduced somewhat if turbines had a horizontally split casing.

Sound maintenance steps cut costs. One of the advantages of the gas turbine is its low lube oil consumption, which has been confirmed in El Paso's experience. A problem did arise in using standard turbine lube oils, however. Foaming was detected at five stations on two different occasions. Oddly enough, the foaming was apparently caused by air entrainment produced by an antifoam agent in the oil. Tests showed that this agent could cause air entrainment in the oil in quantities as low as five parts per million. Removal of the antifoam agent stopped this trouble.

Cost of operation of the gas-turbine stations on the El Paso system has compared favorably with reciprocating stations. Based on horsepower installed, the gas turbine is about 10 percent cheaper to operate. On the basis of horsepower developed, it runs about 30 percent cheaper.

This latter comparison, of course, reflects load factor considerably. However, comparing stations of like load factor this economic advantage still holds true. More experience should give a better evaluation of fuel consumption comparisons.

About the Author

ALEX H. CARAMEROS is a compressor engineer with several years experience in the engineering design, maintenance and operation of El Paso Natural's gas turbine and reciprocating stations. His earlier work included two years as junior physicist at New Mexico A & M's Physical Science Laboratory. He then engaged in research and development work with the General Electric Company prior to joining El Paso. He holds bachelor of science degrees in physics and electrical engineering from Texas Western College and New Mexico A & M College.

ACKNOWLEDGMENT

From a paper presented at the ASME Gas Turbine Power Conference, Washington, D. C. April 16-17, 1956.

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Periodic well-planned maintenance keeps this installation of force-ventilated motors on the line. Maintenance of motors of this type is complicated by the necessity of servicing the associated ventilation equipment.

Maintaining Pipe Line Electrical Equipment

It takes extra care to get the most out of modern electrical motors, switchgear and controls. But it will pay off in more efficient operations, less downtime, and a lower repair bill.

By MERRITT HYDE and D. C. WASHBURN, JR.
Westinghouse Electric Corporation
East Pittsburgh, Penn.

WITH INCREASING USE of electrical equipment in pipe line pumping stations, a knowledge of proper maintenance of electrical equipment becomes increasingly important. This is especially true in view of the nature of the products handled. Improper maintenance leads to situations which are dangerous to both life and property.

Today, use of automatic, unattended and remotely-controlled pumping stations is increasing. As a result, breakdown of any piece of equipment in one of these stations can cause shutdowns which are of extended duration since extra time will elapse while maintenance personnel are en route to the station site.

The sole purpose in maintaining any piece of equipment is to realize maximum expected returns from money invested in that equipment by sustaining or increasing its operating efficiency. Were it not that maintenance of equipment prolongs life and reduces shutdown time of equipment, there would be no point in having a maintenance program.

Operating efficiency of the electrical equipment is especially important in the pipe line industry since pipe lines generally are operated at or near maximum capacity. Optimum performance is achieved by having a continuous maximum throughput.

A good maintenance program for electrical equipment consists primarily of inspection and repair. It also involves proper planning of work, proper testing of equipment, and stocking of an adequate number of renewal parts.

The over-all object of a maintenance program is (1) to reduce the number of necessary emergency repair jobs and (2) to get the maximum useful life out of the equipment. Thorough inspection is necessary to locate faulty conditions early.

Familiarity with equipment will aid maintenance personnel in determining the parts to be inspected most frequently and the best procedures to follow. This is especially true in pipe line operations because of the many sequential operations involved in various control schemes.

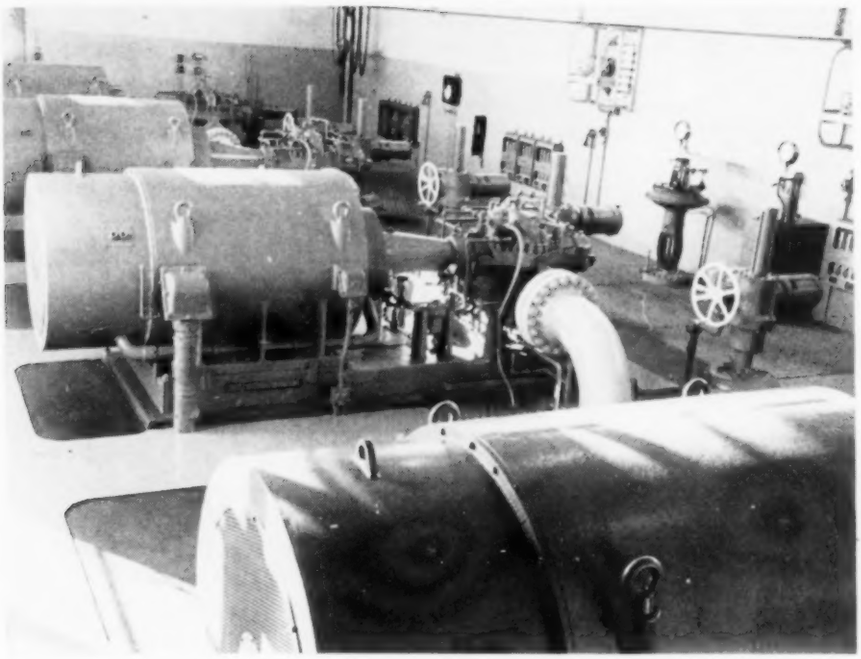
An additional benefit is that this familiarity will point out inherently dangerous maintenance procedures and also indicate the most susceptible points of wear.

A good maintenance program must always consider safety of personnel first and foremost. This is especially important in the pipe line industry where a small mistake in maintenance of electrical equipment in a pumping station could have distastrous results.

Possibilities of fire and explosion, as well as dangers normally associated with incorrectly handled electrical equipment, are ever present.

Keep renewal parts in stock. An adequate number of renewal parts in stock will reduce downtime in the event of emergency repairs. Many items used in electrical equipment found in a pumping station are not stock items with manufacturers. Consequently, a long delay may ensue while a manufacturer makes and delivers parts for repairs.

Conversely, a large amount of money can be invested in unwarranted renewal parts. The National Electrical Manufacturers Association has lists of recommended renewal parts. Manufacturers of electrical equipment also make special recommendations as to the spare parts they



Explosion-proof motors such as these require special care not necessary on equipment located in non-hazardous locations. Proper care of explosion seals is as important as maintenance of 'working parts'.

Auxiliary control center and automatic sequence relays control the pumping station. Here, as at all stations, cleanliness is essential.

advise to have in stock. In addition, manufacturers generally have recommended practices for maintenance of their specific items of equipment.

A good maintenance program reduces the amount of money invested in a stock of renewal parts. It locates potential trouble early enough so that the necessary parts may be ordered in advance of a shutdown. Also, proper equipment and proper care prevent small troubles from developing into major breakdowns.

Explosion seals must be perfect. Explosion-proof pipe line electrical equipment has an explosion seal feature not found on equipment in non-hazardous locations. Proper care of the explosion seals is as important as maintenance of the working parts.

A push button switch in an explosion-proof enclosure, for example, can be more dangerous to the over-all operation if the explosion seals are not handled properly, than if the switch itself were not to function.

In the maintenance of any pipe line electrical equipment, a good, complete set of tools is necessary. Most important, of course, are the instruments and other measuring devices used to determine existing conditions and to give indications of trouble. All should be kept in good condition.

Motor maintenance depends upon inspections, records and cleanliness. There are several types of large motors used in pipe line pumping stations. Almost without exception, they are AC induction motors in a variety of forms. Motors used in hazardous areas are almost always explosion-proof, although in some cases force-ventilated motors are used with the ventilating air drawn from a non-hazardous area. Other motors that are used on occasion are weather-protected motors, or even open motors placed out-doors under a shed.

These latter two types of motors are easiest to maintain. There are no explosion seals involved. However problems are introduced by exposure to weather.

Force-ventilated motors and self-ventilated motors have no explosion seals, but maintenance of the force-ventilated motor is complicated by the need for maintaining the associated ventilation equipment.

In the maintenance of any type motor, clean equipment is the primary consideration. Care should be exercised to see that motors are free from dirt, moisture, and other contaminents such as oil and solvents. If a motor is dirty, ventilation is impaired. Consequently it will operate at a higher temperature. This increase in operating temperature causes a decrease in the expected life of the motor insulation.

Also, some contaminants will in themselves cause a deterioration of insulation. Periodic inspections, as determined by operational conditions, are a must.

Complete records of the machine's past history is essential in maintenance work. Condition of the motor stator insulation, for example, can be determined if a record has been kept of insulation resistance or "megger" readings at regular intervals. Any particular reading is not too conclusive, but the general trend of insulation resistance can be followed by keeping records. Dangerous or unexpected developments can be noted quickly.

Avoid over loads to protect insulation. Overloading of equipment is dangerous, and should be avoided. Overloads from unknown causes should not be permitted. The mere fact that there is an overload indicates trouble.

Operation of motors on unbalanced voltages also is detrimental to a motor in causing overheating. Overheating, no matter what the cause, results in deterioration of insulation and eventually will lead to premature failure.

Bearing failures lead to greater damage. Maintaining motor bearings in good condition is essential for proper operation of a motor. A bearing failure is costly, not only in time

and lost service, but also in maintenance manpower.

A simple bearing failure, in itself bad enough, can lead to more severe damage, not only of the motor, but also of connected equipment. For example, in an explosion-proof motor, a bearing failure can let the moving shaft down far enough to damage the explosion seals. Then, before the motor can be run again, both the bearing and the explosion seals must be repaired.

Other damages that can result are the scoring of the journals and damage to the rotor and stator itself from rubbing. A periodic check of the air gap of a rotating machine during shut down can help in determining the wear of bearings when records have been kept of previous measurements.

Watch bearing lubrication. Bearings used in pipe line motors are one of two general types, sleeve bearings or anti-friction bearings. Both types also are made either in sealed or plain form. One of the major sources of trouble or causes of bearing failure is intrusion of foreign material into the bearing lubricant. This problem is not as serious in the sealed types.

With anti-friction bearings, deterioration of the lubricant and also over-lubrication are possible sources of trouble. Over-lubrication will cause an anti-friction bearing to overheat and possibly lead to failure.

In a sleeve bearing, inadequate lubrication is a serious condition. Since oil in a sleeve bearing is necessary for maintenance of an oil film between journal and bearing, inadequate lubrication will allow metal-to-metal contact between the journal and bearing with consequent failure of the bearing.

If the sleeve bearing is over-lubricated, oil and oil vapor may be forced from the bearing housing and possibly could be carried by ventilating air into the machine. Here oil may collect and form an adhesive-like coating for collection of dust and dirt. In any case, oil leakage leads to objectionable conditions.

One advantage of sealed sleeve bearings over plain bearings is that oil contamination and loss of oil virtually is prevented; therefore, the primary maintenance job with a sealed sleeve bearing is that of maintaining proper oil level in the bearing. If a sealed sleeve bearing begins to require frequent refilling of oil, a check should be made of the condition of the seals to see that their clearances from the shaft is in accordance with the manufacturer's recommendations. Periodic checks of the condition of the bearings are necessary to proper maintenance.

Keep bearing insulation effective to stop bearing currents. One point that may be overlooked in the maintenance of bearings, especially in larger machines is that of bearing insulation. This insulation generally is put in to insulate one bearing of a large machine from the frame so as to break the path of flow of bearing currents. Manufacturers insulate one bearing pedestal or bracket of the larger machines from the bedplate or frame. Care should be taken when working on or around machine bearings to see that this insulation is not shorted out. This should be watched particularly in the installation of oil piping or bearing temperature detecting devices. Anti-friction bearings as well as sleeve bearings can be affected by the circulation of bearing currents.

Inspect switchgear regularly for proper operation. Grounding of motors and condition of surge protective equipment should be carefully checked. This equipment generally is associated with power switching, so maintenance of switchgear is the next type of equipment to be considered. Here again, cleanliness is important. Periodic checks of the switchgear should be made.

Every precaution should be taken to make sure that switchgear units to be worked on are de-energized. All possible safety precautions should be taken to prevent accidental contact with any energized circuit.

An inspection of the switchgear should be made for checking tightness of electrical connections, freedom from binding of the moving parts and broken or missing parts. Where possible, a manual check of the circuit breaker operation should be made. This check of breaker operation should include a check of contact adjustment and proper mechanical operation of the tripping mechanism.

On air breakers, a check should be made of the arc chutes to make sure that they are mechanically satisfactory and not in some way clogged with foreign material. Inspection of the contacts should be made for any excessive burning or wear. If it is found necessary, replacements should be made.

Also, an inspection of the shunts to the moving contacts should be made to be sure that they are not breaking or fraying. Also, it should be noted whether there are any signs of overheating. If there are, the cause should be determined and corrected.

Test oil in breakers. On oil breakers, again, mechanical checks should be made. In addition, periodic samples of oil should be withdrawn from the breaker tank and given a dielectric test. Should the oil have a low dielectric strength as determined by tests, it should be filtered and tested again. If satisfactory, it can be reused; if it still does not have a sufficient dielectric strength, it should be replaced with new oil. In using new oil, it should be tested before use to make sure that it is satisfactory.

Care should be exercised to see that oil is not contaminated by pumping through a rubber hose or other sulfur-containing pipe. Nor should it be contaminated by certain solvents, for example, carbon tetrachloride. These contaminants, which cannot be removed by simple filtering, will cause deterioration of the desirable qualities of the oil.

Insulation resistance tests of the switchgear may be made to determine general condition of insulation. A point to watch in making "megger" tests of switchgear is to be sure that surge protection equipment is removed from the circuits before testing. Otherwise, erroneous results will be obtained.

Another item to check when the switchgear is de-energized is condition of the current transformers. A check should be made of the insulation and of the secondary wiring to make sure it is complete and that all connections are tight. When checking the insulation, grounds should be removed. Care must be exercised to see that grounds are replaced after the test.

Watch for burning and wear in high voltage contactors. In many cases, high voltage contactors rather than circuit breakers are used for starting large motors. In maintenance of these contactors, the same general rules apply as for switchgear. Moving parts can be lubricated very lightly with a non-oily lubricant such as

graphite; however, very close attention should be paid to manufacturers' recommendations. Contact burning and wear should be determined and, if necessary, contact replacements made.

Low voltage relays and auxiliary contactors are used extensively around pipe line pumping stations, especially in automatic and remotely operated stations. Since voltages are low, a great amount of trouble can be experienced from dirt and dust. With the lower voltages, poor contacts will cause overheating. In certain areas, there may be large quantities of sour gas in the atmosphere to cause corrosion.

Condition of the contacts on these low voltage relays and contactors is very important, and they should be checked very carefully. Since these contacts are usually either silver or silver alloy, they are very soft. If any cleaning is done, it must be done carefully. The effect of cleaning may be equivalent to many months of normal wear.

If it is necessary to remove pits or otherwise dress the contacts, very fine sandpaper or a very fine file should be used. Emery cloth is damaging since the abrasive grains are conductors. Contacts should be carefully inspected to see that no fine grains of abrasive from the sandpaper remain in the contacts. Coils of these relays should be inspected for overheating, tested for continuity, and replaced if necessary.

Check "shading" coils on AC contactors. When contactors operating from AC are used, attention should be paid to the "shading" coil. This is a special low resistance coil inserted in a portion of the pole face of the contactor armature to prevent the relay or contactor from buzzing or chattering. If this coil is not in good condition, the relay or contactor will buzz or chatter, and may cause contact pressure to be reduced enough to cause overheating of the contacts.

Most of the contactors used for motor control have thermal overload trip devices. The essential thing here is to make sure that the proper size heater element is being used and that all connections to the element are tight. Loose connections cause excessive heat generation and may cause inadvertent tripping.

Voltage checks should be made to make sure that equipment is not operating on excessive under-or-over voltages. If voltage is low, motors draw excessive current for a given load and the contact pressure of contactors is reduced. Both of these effects lead to overheating of equipment. If the voltage is too high, overheating again is the result. An abnormal number of coil failures might be anticipated.

Here again, cleanliness of the mechanism is important. Arc chutes should be kept clean, and proper contact pressure should be maintained. Shunts should be checked to see that they are in good condition. Moving parts should be inspected for the proper freedom of action. Circuits also should be checked for grounds.

Inspect transformers frequently —prevent overloads. Maintenance of transformers in an electrical pumping station is probably easiest of all. The main thing is to keep dry type transformers clean and oil in oil-filled transformers in proper condition. Periodic inspections and test of the oil should be made as is done for oil breakers. Mechanical parts should be kept in good condition.

Probably the biggest service difficulty experienced with transformers is broken bushings. These should be inspected and replaced if necessary. Overloads can be very deterimental to transformer life. Many transformers now use some means of forced cooling. If forced cooling is used, inspection should be made of the cooling equipment to be sure that it is in proper operating condition.

Some transformers operate with an inert gas, such as nitrogen, over the oil in the tank to prevent the transformer from breathing moisture into the tank. Inspections should be made at periodic intervals to be sure that this gas is maintained.

With proper care, electrical equipment should give longer, more trouble-free life than any other type of equipment used in a pipe line pumping station.

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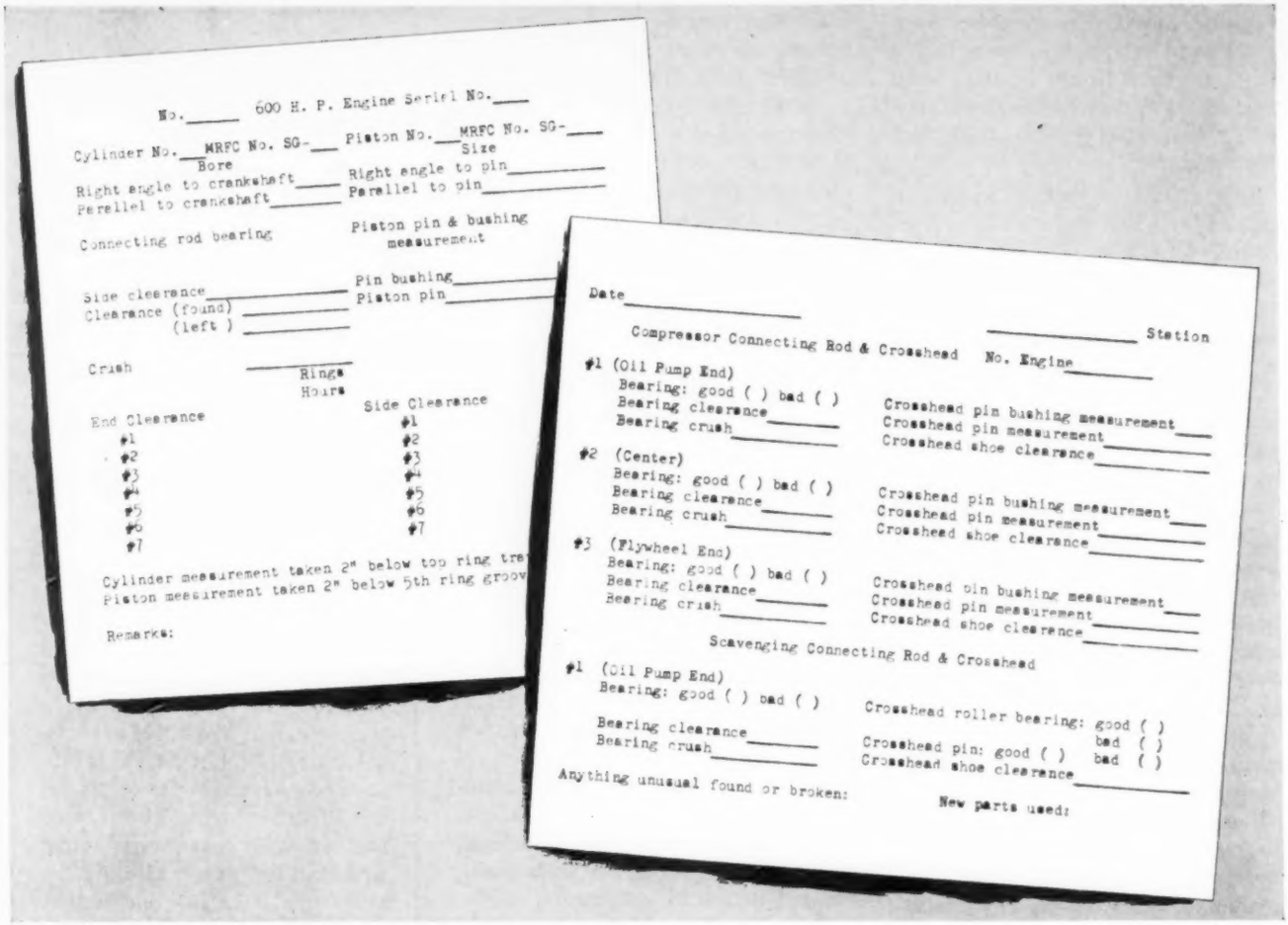
About the Authors

Hyde

Washburn

MERRITT HYDE, specialist with Industry Engineering department of Westinghouse Electric Corporation, is a native of Ohio. He graduated from Marietta College, majoring in physics, and studied electrical engineering at Case, obtaining a bachelors degree and an E. E. degree. In 1948, Marietta awarded him a Sc.D. Hyde joined Westinghouse when he left engineering school and worked with electrification problems in general industry mills and later in construction industry applications. In 1935, he was electrical consultant on the 1260-mile Plantation Pipeline from Baton Rouge, La., across the southeastern states, and later did engineering work on the Big Inch and the Little Big Inch Lines.

D. C. WASHBURN, JR., is a 1949 electrical engineering graduate of the University of Colorado. After working in engineering contracting for several years, he served with the Army Corps of Engineers in Alaska until 1953. Washburn then joined Westinghouse's Engineering & Service department in Houston, Texas, and later moved to El Paso, working as engineering assistant to some of the major gas transmission companies in that area. Early this year, he joined the Westinghouse Industry Engineering headquarters in East Pittsburgh where he has been working on extending the use of electrical equipment in the pipe line and refining industries.



No._____ 600 H. P. Engine Serial No.____

Cylinder No.__MRFC No. SG-___ Piston No.__MRFC No. SG-___
Bore Size

Right angle to crankshaft_____ Right angle to pin_____
Parallel to crankshaft_____ Parallel to pin_____

Connecting rod bearing

Side clearance_____
Clearance (found) _____
(left) _____

Crush _____

Piston pin & bushing measurement

Pin bushing_____
Piston pin_____

Rings
Hours

End Clearance
#1
#2
#3
#4
#5
#6
#7

Side Clearance
#1
#2
#3
#4
#5
#6
#7

Cylinder measurement taken 2" below top ring tra
Piston measurement taken 2" below 5th ring groov

Remarks:

Date_____

_____ Station

Compressor Connecting Rod & Crosshead No. Engine_____

#1 (Oil Pump End)
Bearing: good ( ) bad ( )
Bearing clearance_____
Bearing crush_____

Crosshead pin bushing measurement___
Crosshead pin measurement_____
Crosshead shoe clearance_____

#2 (Center)
Bearing: good ( ) bad ( )
Bearing clearance_____
Bearing crush_____

Crosshead pin bushing measurement___
Crosshead pin measurement_____
Crosshead shoe clearance_____

#3 (Flywheel End)
Bearing: good ( ) bad ( )
Bearing clearance_____
Bearing crush_____

Crosshead pin bushing measurement___
Crosshead pin measurement_____
Crosshead shoe clearance_____

Scavenging Connecting Rod & Crosshead

#1 (Oil Pump End)
Bearing: good ( ) bad ( )

Bearing clearance_____
Bearing crush_____

Crosshead roller bearing: good ( )
bad ( )
Crosshead pin: good ( ) bad ( )
Crosshead shoe clearance_____

Anything unusual found or broken:

New parts used:

Engine cylinder check sheet above provides a complete record. On it are recorded the number of hours on rings plus measurements of pistons, cylinders and connecting rods. A permanent record for compressor and scavenging parts is shown at right. Note that the location of each rod is shown so that the foreman can check data at a glance.

Foreman's Repair Records Speed Overhaul

Make up these sheets to fit your own type engines and compressors. They may be quickly printed at low cost to reduce labor and eliminate oversights during station repairs.

REPAIR RECORDS can be a valuable tool to reduce labor costs and expensive oversight if the foreman is properly equipped.

One of the best ways to keep proper records is the check sheet, tailor-made to the foreman's own needs. Other methods invariably result in costly omissions. During a complete overhaul repairmen often forget various repair items when they have to outline the repairs themselves.

Check sheets are particularly valuable for:

- Two and four-cycle gas engines.
- Compressor and scavenging parts.
- Main bearings.
- Crank shaft alignment.
- Compressor valves.

In addition to keeping accurate records on the items mentioned above, it is also wise to have a typed monthly report on minor repairs, ignition trouble, magneto repairs, replacement parts used and hours run on injection valves. Check forms covering these items can be run off on a duplicator and kept in ample supply before overhaul.

With an organized system of check sheets and permanent record forms the foreman knows the correct number of hours run on cylinders, pistons, rings, all connecting rod bearings, bushings, main bearings and all vital engine parts. From this information the foreman also can estimate more readily the cost of replacements from year to year—a great help in any operation.

These suggested check sheet and permanent record forms cover repairs common in pipe line work. They will help reduce costs in maintenance operation.

Record of Compressor Valve Breakage

Date	Time	Eng.	Comp.	Time Lost	Valve Location: Suc.	Dis.	Lft.	Rt.	Int.	Outb.	Materials Used: L.Plt.	W.Plt.	S.Plt.	L.Sp.	W.Sp.	S.Sp.	L.Gask.	S.Gask.	Remarks

Station

Date

No. Cylinder & Piston

Ring gap clearance	Ring side clearance
#1	#1
#2	#2
#3	#3
#4	#4
#5	#5
#6	#6
#7	#7

Cylinder measurement 2" above ports:

right angle to crankshaft
parallel to crankshaft

Found power rings: stuck ( ) good ( ) worn ( ) broken ( )
Carbon in ring grooves: light ( ) heavy ( ) dry ( ) gum ( )
Found oil wiper rings: stick ( ) good ( ) worn ( ) broken ( )
Carbon in oil ring grooves: light ( ) heavy ( ) dry ( ) gum ( )
Found cylinder: good ( ) scored ( ) worn ( ) cracked between ribs ( )
Found piston: good ( ) scored ( ) worn ( ) cracked ( )
Found c.l. head: good ( ) new crack ( ) metalocked ( ) metalock cracked ( )
Found carbon in piston oil reservoir: light ( ) heavy ( )
Found carbon in scavenging air ports: light ( ) heavy ( )
Found carbon in exhaust: light ( ) heavy ( )
Cleaned and pumped oil through oil checks ( )

Anthing unusual found or broken:

New parts or gaskets used:

Station

No. Engine

Bearing: good ( ) bad ( )
Bearing side clearance
Bearing clearance
Bearing crush

Piston pin bushing measurement

Piston pin measurement

Piston measurement O.D. 2"below 5th ring groove:

right angle to pin
parallel to pin

Date

Main Bearings

No. Engine

#1 (thrust) bearing clearance ___ taken by dial indicator ( ) taken by lead wire ( )
bearing crush ___ thrust clearance ___ opened up: yes ( ) no ( )

#2 bearing clearance ___ taken by dial indicator ( ) taken by lead wire ( ) opened up: yes ( ) no ( )
bearing crush ___

#3 bearing clearance ___ taken by dial indicator ( ) taken by lead wire ( ) opened up: yes ( ) no ( )
bearing crush ___

#4 bearing clearance ___ taken by dial indicator ( ) taken by lead wire ( ) opened up: yes ( ) no ( )
bearing crush ___

#5 bearing clearance ___ taken by dial indicator ( ) taken by lead wire ( ) opened up: yes ( ) no ( )
bearing crush ___

#6 bearing clearance ___ taken by dial indicator ( ) taken by lead wire ( ) opened up: yes ( ) no ( )
bearing crush ___

#7 bearing clearance ___ taken by dial indicator ( ) taken by lead wire ( ) opened up: yes ( ) no ( )
bearing crush ___

Anything unusual found or broken: New parts used:

Date

Crankshaft Alignment

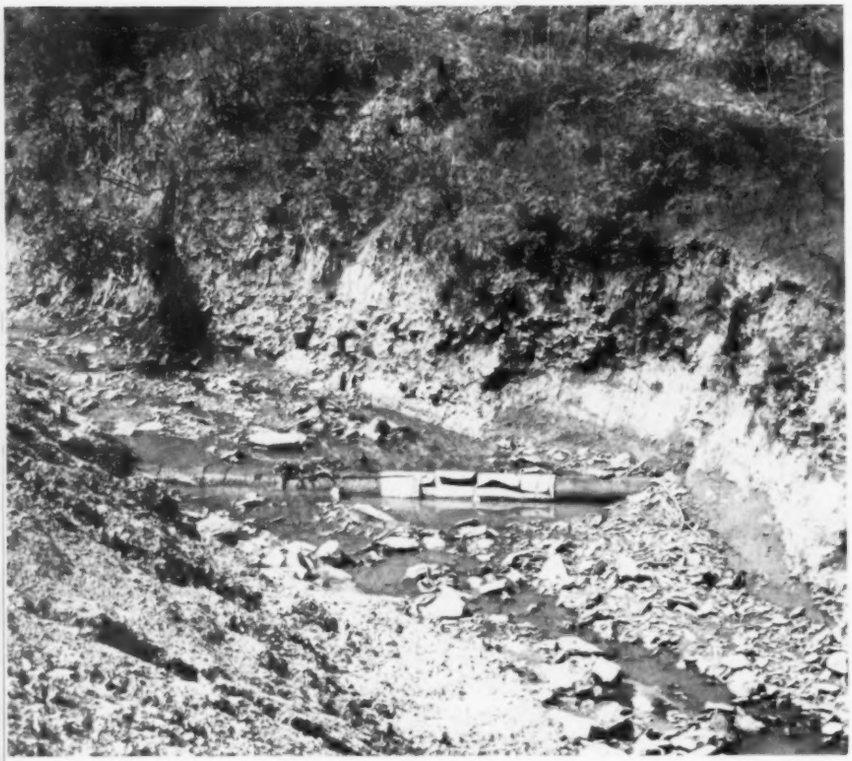
Station

No. Engine

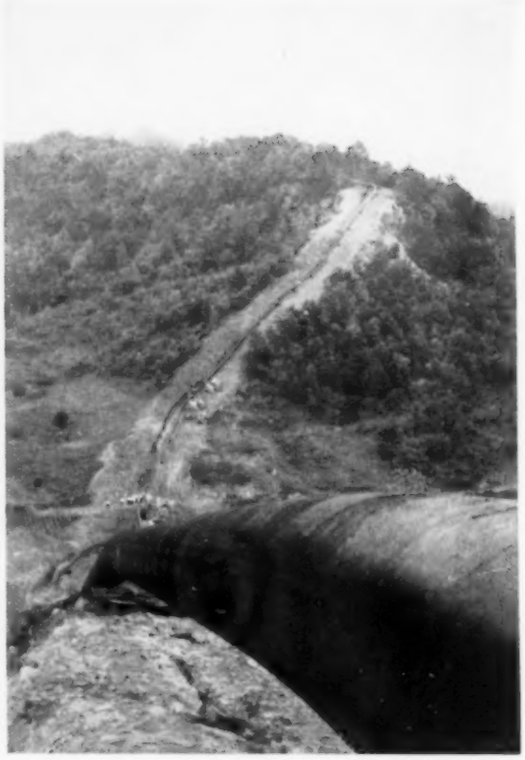
	Found	Left		
#1 (throw)				
Dial under comp. conn. rod scav. side				
Dial on bottom				
Dial on 90 deg. exhaust side				
Dial on top				
Dial over comp. conn. rod scav. side				
#2 (throw)				
Dial under scav. conn. rod scav. side				
Dial on bottom				
Dial on 90 deg. exhaust side				
Dial on top				
Dial over scav. conn. rod scav. side				
#3 (throw)				
Dial under on scav. side				
Dial on bottom				
Dial on 90 deg. exhaust side				
Dial on top				
Dial over on scav. side				
#4 (throw)				
Dial under comp. conn. rod scav. side				
Dial on bottom				
Dial on 90 deg. exhaust side				
Dial on top				
Dial over comp. conn. rod scav. side				
#5 (throw)				
Dial under scav. conn. rod scav. side				
Dial on bottom				
Dial on 90 deg. exhaust side				
Dial on top				
Dial over scav. conn. rod. scav. side				
(throw)				
Dial under comp. conn. rod scav. side				
Dial on bottom				
Dial on 90 deg. exhaust side				
Dial on top				
Dial over comp. conn. rod scav. side				

...s made:

Top form records all overhaul data needed for most valves, including a column for time lost. Shown at top left is a check sheet for each cylinder and piston. One should be kept for each cylinder to provide a comparison for later overhauls. Lower check sheet is typed as a permanent record for work on main bearings. Information from this sheet is combined with record form at right to check crankshaft alignment. First column gives location of alignment each throw. Other columns are used as bearings are worked over. Changes made after each reading are listed at bottom of columns. Upon completion of overhaul, the final reading on all throws is entered in last column.



Severe gully erosion exposes pipe line to mechanical and corrosion damage. This pipe line had been buried approximately four feet under the floor of the gully when constructed.



Erosion problems demand special attention in steep, hilly country. This pipe line is part of a West Virginia gas transmission system.

Soil Conservation Pays Along Right-of-Way

Construction spreads are key to good soil saving practices. Many operating pipe line companies encourage farmers to control soil erosion . . . and they are finding it cuts down on maintenance problems.

By RICHARD HOYT
H. C. Price Company
Bartlesville, Oklahoma

IN AN EFFORT to protect the large investment in buried pipe lines, operating companies and contractors are assisting farmers in controlling soil erosion through good conservation practices. The landowner sets the pattern to be carried out in each field. Good methods prevent loss of soil to wind and water erosion and keep protective and supporting cover around the line.

The best way for the pipe line company to be assured of a stable and permanent cover over its lines is by encouraging sound farming practices to hold the soil in place. This is why many operating pipe line companies have become active in the field of soil conservation. How they are doing this is an interesting story involving an increasingly greater degree of cooperation between pipe line companies, landowners and the Soil Conservation Service.

Contractors are key men in right-of-way maintenance. Since the people who have the initial contact with the farmer are the people who actually build the pipe line, pipe line construction spreads are in a key position to assist the operating company in the program of cooperating with the farmer. The manner in which they work with landowners will have much to do with the first opinion the farmer has of the operating pipe line company.

Recognizing this, progressive contractors place emphasis on the importance of dealing directly with the farmer and not around him. Time after time the wisdom of making a frank explanation of construction methods and operations has thus been proven through the resulting cooperation of the landowner.

By paying constant heed to right-of-way limitations while building the line and by exercising painstaking care in cleanup operations, pipe line contractors contribute greatly to good relations between the operating company and the landowner. Proper care when cleaning up right-of-way cannot be too greatly emphasized, for it is over this land that cooperation in erosion control measures really pays off.

Seeding right-of-way after clean-up holds soil. Following clean-up, it is important that the ground be re-seeded as soon as pos-

The first step toward proper conservation measures for a pipe line right-of-way is with the construction of the line. Here a clean, smooth surface is ready for immediate seeding.

sible and that precautions be taken to insure adequate soil cover. While contractors have at times even been involved in the re-seeding operation, this is generally where the operating company takes over. As a part of the long-range pipe line maintenance program, their planning for future use of this land is of great importance.

Perhaps the greatest effort to conserve soil has been made through the formation and operation of soil conservation districts over the nation. With the cooperation and assistance of farmers and ranchers, the U. S. Department of Agriculture has organized over 2300 soil conservation districts in the U. S. Operating under the direction of the Department of Agriculture, the national Soil Conservation Service works with the farmer through these districts.

The Soil Conservation Service also performs valuable services in the form of developing improved conservation methods through experimentation and study.

The direct interest of operating pipe line companies in such a land improvement program stems from the costly ravages of soil erosion that have plagued farmers for so many years. Badly eroded land may have deep soil cuts and gullies that will completely expose the pipe line to dangers of breaks. Working with the farmer and advisers of his soil conservation district, the pipe line company aids in working out a program of land-use that will assure the farmer of maximum benefits from the use of his land while providing permanent cover for the pipe line.

One of the important services provided by Soil Conservation Service is the land-use capability survey. This is a physical inventory and analysis of the land. By using this detailed information, different kinds of land on any particular watershed or farm can be evaluated for recommendations of land treatment. In many instances, concessions for putting right-of-ways to different use have been given by farmers upon a thorough review of the land-use survey and by cooperating with him in control measures on other parts of the farm.

Failure to conserve soil leads to line damage. The importance of this kind of planning is indicated by past experience. Over the past 20 years, there have been a large number of cases where soil erosion has caused major problems for pipe line operators. On some hillside right-of-ways more than 50 percent of the soil cover over the line has disappeared. In other places where erosion control measures have been absent, water runoff gullies have completely exposed pipe lines causing excessive strain and occasional breaks.

On the other hand, investigations of areas where conservation practices have been applied, such as terracing, contour farming, and re-seeding, the depth of cover has been maintained and occasionally even increased.

An important example of what control measures can mean under extreme circumstances is that of a pipe line through western Iowa. In 1947, this area experienced a major flood which wiped out 700 bridges and culverts on main highways and 2000 on secondary roads. The pipe line company, which had been operating a soil conservation program, had little backfill replacement and absolutely no trouble on the line.

Keeping in mind that the first interest and obligation of a pipe line company is to supply fuel to consumers on an uninterrupted schedule, it is becoming more apparent that soil conservation programs play an important part in meeting that obligation, while reducing problems and maintenance cost at the same time.

FIGURE 1—Arrow indicates portion of San Joaquin Valley-to-Los Angeles line that was cleaned with detergent solution.

FIGURE 2—Heavy deposits were found in the pipe line at several points. Flow tests indicated a low efficiency so cleaning operations were planned on this mountain line.

So. Cal. Gas Boosts Efficiency by . . .

Detergent Cleaning a Mountain Pipe Line

Washing a 14-mile section of 22-inch line in the Tehachapi Mountains increased flow efficiency from 71 percent up to 92 percent. Cost of cleaning the line—only $650 per mile.

By A. S. OLSON
Southern California Gas Company
Los Angeles, California

WASHING DEPOSITS out of gas transmission lines with detergent-water solutions in mountainous terrain presents some tough control problems. The many successful cleaning jobs completed in relatively flat country already have proved the method. It will work well in mountains, too, but careful advance planning is necessary; and control must be well coordinated throughout actual washing operations.

Physical characteristics of the pipe line dictate the equipment and methods to be used in mountain cleaning. Southern California Gas Company's 16-mile section of 22-inch pipe line is located in the Tehachapi Mountains between Bakersfield and Los Angeles. It was laid in 1929. Pipe lines in the floor of the San Joaquin Valley to the north had been cleaned internally as conditions required, but no previous attempt had been made to clean the line from the valley up into the mountain range.

While replacing sections of line after leaks had developed in wrinkle expansion joints, maintenance crews found large accumulations of deposits in the line. Further inspection of the 22-inch line showed the bulk of the material to be in the 14-mile section through Grapevine Pass. Here the line rises from an elevation of 1700 to 4500 feet. Low efficiency in flow tests indicated large quantities of foreign material in the line, so cleaning plans were initiated immediately.

Ball-and-Chain Crawler Used. An inflated ball-and-chain crawler was forced through the line to move heavy deposits out of sags and spread them down the line. This run made the work of the washing pigs much easier. The crawler works best when half-filled with water and inflated with nitrogen. When it had passed through

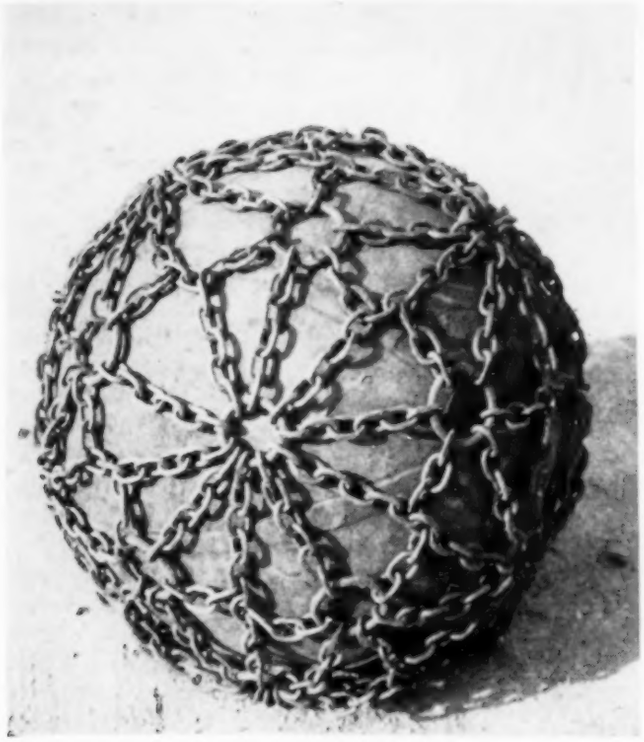


FIGURE 3—An inflated ball and chain crawler first was run in order to make sure no obstacles would prevent running a pig; also to spread heavy deposits down the line away from sags. Best results with crawler were obtained when it was half filled with water and inflated with nitrogen.

FIGURE 4—A special pig sender was designed, which greatly reduces time and effort to insert the pig into the line. A 10-foot section of the 22-inch pipe was chained to a cradle on the winch truck bed. Running the winch line through the sender and attaching to the pig permits the pig to be pulled into its starting position easily and quickly.

the line, it removed obstructions and reduced chances of stuck pigs.

A short coupled pipe line pig was selected for the cleaning job to move around the pipe line's sharp angles. This pig has 2 heavy rubber cups and 12 brushes. Mounted inside is a whistle which helps to locate the pig as it moves through the line. It also has bypass nozzles which may be opened individually to permit more gas flow through the brushes to keep them clean and carry the material ahead. During the few dry pig runs made in the cleaning job, one to four of these bypass nozzles were kept open.

Pig "Sender" Speeds Cleaning. To insert the tight fitting pig into the line quickly and start it on its run, a special fitting was made up. A 10-foot section was cut from 22-inch pipe and fitted in a cradle which extended down through the bolster pin holder of a winch truck. The joint was then chained in place by load binders, and a 24-inch loose fitting sleeve, swaged down to 22-inch, was fitted to the rear end. The winch was used to pull the pig into the "sender" and then it was ready for installing in the line with bolted couplers.

To catch the pig at the downstream end of the section, a slotted-type receiver was first used. This receiver worked well, but for better control, it was necessary to go to a gas-tight receiver. This one made up of a short section of 22-inch pipe with a bull plug and a 6-inch connection off the bottom. This connection tied into a 6-inch valve used to throttle the effluent and control the pig movement. This pig receiver also simplified the problem of keeping air out of the line.

Deposits Analyzed. Before beginning cleaning operations, a laboratory analysis was made of several samples of the deposits found in the line. Here is a typical analysis:

	Percent by Weight
Oils	21.8
Water	3.0
Iron as Fe_2O_3	64.0
Silica	10.1
Sulfur as elemental S	0.7

Traces of Sulfates and Chlorides.

The laboratory picked a number of detergents to test with this material and chose the one that would best emulsify the oil and disperse the solid particles in suspension. A slightly alkaline detergent was used in proportions of one-half pound to one gallon of water.

Agitation of this solution as it moved along the line aided removal and emulsification of the line deposits. To do this during the cleaning runs, gas was permitted to pass through the pig and bubble into the solution ahead.

Control Plan. After selection of the right detergent and adequate equipment, the next big step was to draw up a plan to use in controlling pig travel. Existing maps provided a relatively accurate plan of the pipe line. It was necessary to survey the ground elevation over the line to draw a suitable profile because accurate profiles had not been prepared when old lines were laid. Both the plan and the profile were used constantly during the cleaning operation for placement of personnel along the pipe line to check pig travel. The drawings were also valuable in making up a timetable of the pig's progress and checking its clearance at critical locations along the line.

For best control, the job was divided into two sections—one 5 miles long; the other, 9 miles. The 9-mile section, extending from Lebec to Grapevine, has an elevation change of 2000 feet. To further complicate cleaning, it crosses a highway four times.

FIGURE 5—Operator at gas-tight receiver, throttles flow of fluid emerging through 6-inch line to control speed of pig.

This section was cleaned downhill and in the direction opposite to normal gas flow. To prepare it for cleaning, the main line valve near the center of this section was replaced with a flanged spool. The pig sender and receiver were then installed and the line was ready for cleaning operations to begin.

The ball-and-chain crawler was forced through the line with a gas pressure of 2 to 6 pounds per square inch. The crawler took 1 hour and 27 minutes to move through the 9-mile section. No material was carried ahead of it into the receiver.

Next, an exploratory run was made with a solution of 1000 gallons of detergent-water solution followed by a pig. This softened the deposit for the later cleaning runs and removed some of it; about 2600 gallons of material came out of the line. The time for this run was 6 hours and 39 minutes. For the first cleaning run, a solution of 3100 gallons was put through the line ahead of the pig. This time about 5200 gallons of material came out at the receiver. Two pigs were used with the last rinse run. The first was the same short coupled type as used on the washing runs; the second was a squeegee pig. Approximately 3700 gallons of clean water was used and over 5000 gallons of fluid was discharged at the receiver.

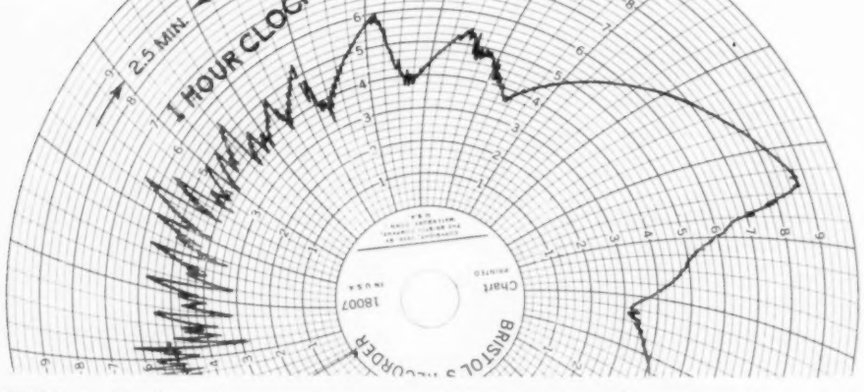


FIGURE 6—One-hour chart records pressures behind the pig, with constant volume of gas entering the line behind it.

Careful Planning Required. Cleaning methods sound simple, but operations demanded detailed advance planning and careful control. Pig movement was controlled by a 2-inch bypass with a throttle valve around the main line valve upstream from the pig sender and a 6-inch blowdown or stack valve at the same location used to lower the pressure back of the pig. In addition, a 6-inch throttle valve at the pig receiver controlled the pressure ahead of the pig and thereby regulated its travel. This was very important. A dry pig will move at high speed in mountainous terrain and may cause pipe line damage if allowed to run free. Fluid ahead of the pig provides some braking action as it starts to accelerate.

Before starting pig runs, both the plan and profile of the line were studied to determine points where the pig could get stuck. Points of rapid elevation change were located so control changes could be made as the pig approached, to keep it under positive control as it started downhill.

To carry this out, a detailed operating plan was prepared for each run before it started. It included a step-by-step procedure for the work, plus a log sheet posted by the supervisor to check rate of pig movement. This log also contained an estimated time of arrival of the pig at each key point along the line. Men stationed at each of these points during the run sent radio reports to the supervisor when they heard the pig pass. From these reports, the supervisor could check progress of the run and give pressure change orders by radio to the upstream and downstream control points. Each log sheet showed the differences in elevation between the points to help determine if pressure required to move the pig compared closely with calculated driving pressures.

Picture of Pig's Travel. The 1-hour pressure chart (Figure 6) shows pressures behind the pig with a constant volume of gas entering the line. When pressure increased, the pig moved a short distance through the line and stopped. This action was repeated until the pressure was great enough

o give the pig a continuous run. Pressure then decreased until it was not enough to keep the pig moving. Pressure at the control point was watched continuously as this cycle was repeated over and over down the line.

As the pig approached sharp turns or elevation changes and the chart indicated that it was on a continuous run, pressure was changed at the control points so it would make the angle at slower speed.

Location of the pig was closely coordinated with pressure readings. For example, on the chart shown, the pig was traveling through the line with a driving pressure of from 3 to 6 pounds per square inch at first. At one point, indicated on the right side of the chart, pressure built up from 4 to 9 pounds with no movement of the pig. Here the pig was moving up an incline and additional pressure was required to push it to the top.

Special Precautions. Both the upstream and downstream control stations took special precautions at critical points caused by the mountainous terrain. Figure 7 shows the line profile where elevation increased 90 feet in 300 feet of pipe. It was necessary to increase pressure behind the pig to 47 psi to force the pig and cleaning solution over the hill. As the pig moved up the hill, the 6-inch control valve at the receiver was closed. The instant the line spotter radioed that the pig had passed the top of the hill, the driving gas was cut off and gas was blown off behind the pig. Pressure at the receiver rose to 11 psi. When pressure at the control valve reduced to 11 pounds, equalizing pressure on both sides of the pig, the stack was closed. No more gas was admitted to the system. The pig was moved the next 2½ miles to the receiver by blowing gas at the receiver.

Fortunately, there were no sharp turns immediately downhill from the location where the pig had the 47-pound pressure build-up. Had this situation occurred, it would have been necessary to install the receiver closer to the foot of the hill to provide a higher pressure ahead of the pig when it started to coast. Another way to handle this condition would have been to install a large vent or stack at the top of the hill to lower the pressure rapidly behind the pig after it passed the summit.

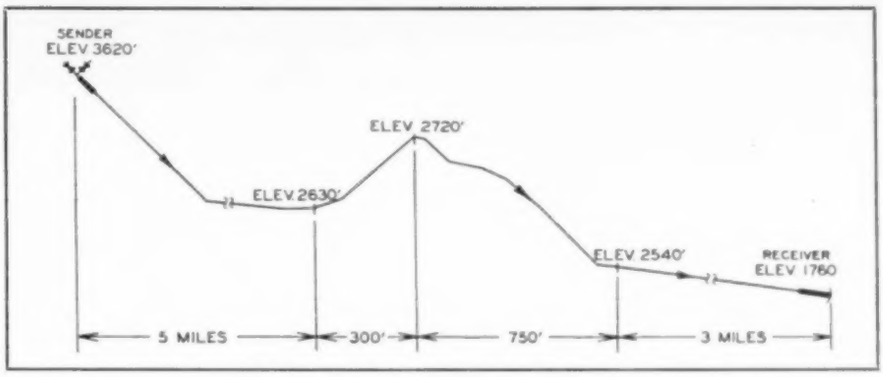


FIGURE 7—Profile of one section of pipe line having an elevation increase of 90 feet in 300 feet of pipe. Close control of pressures behind the pig, as well as pressures at the receiver, were necessary during the deterging operations.

FIGURE 8—That the detergent method of cleaning the pipe line was effective is proved by this view of typical portion of cleaned line; Calculated efficiencies rose from 71 percent before cleaning to 92 percent after cleaning.

Control of the pig on sharp grades was really only one part of the problem. Equally important is control at sharp turns such as those encountered near road crossings. For example, at the crossing of U. S. Highway 99, the pig traversed two 70-degree angles. Pressures at both control points were watched carefully. When the pig was about 1500 feet from the first angle, it was moving with 2 psi behind it. At this point, the receiver was closed and the gas entering at the control location was cut off. A minute later, the pig was 750 feet from the turn with 1¾ pounds behind it; only 30 seconds later, with 1½ pounds pressure, it passed the first angle. It was not heard as it passed the second angle because of highway noise. Ten minutes later, after the pressure had been slowly increased to 2¼ psi, it passed the spotter stationed 555 feet below the second turn.

Results and Cost. An estimated 400 barrels of material was removed from the line by the two detergent washing runs. Before cleaning, the calculated efficiency of the section was 71 percent; after washing with detergent solution, similar calculations showed that it had been increased to 92 percent.

Costs were somewhat lower than estimated. Direct expenses of cleaning the 9-mile section of line was $650 per mile. One month later, a 16-mile section of 18-inch line in similar terrain was cleaned for only $263 per mile by the same method. **The End**

ACKNOWLEDGMENT

This article abstracted from a paper presented at the Pacific Coast Gas Association Gas Supply and Transmission Conference, Las Vegas, Nevada, April 23-25, 1956.

A practical maintenance tool . . .

FIGURE 1—Portable, battery-powered, audible indication equipment is particularly suitable for tank inspection. Equipment weighs only 13 pounds, permitting operator to work from scaffolding either inside or outside tank.

Ultrasonics Speed Inspection Of Piping, Tanks and Engines

Using newest precision-engineered ultrasonics instruments, inspectors obtain accuracies of ¼ to 1 percent of metal thickness. The method is economical too.

By DWIGHT J. EVANS, Engineering Test Services, Inc., Tulsa

MAINTENANCE OF PIPE LINE facilities often calls for careful inspection to determine the thickness of metal structures, either for future design plans or safety. Early methods made it necessary to take equipment out of service, drill a test hole, measure thickness with a micrometer, and then reweld. This was costly, both in time and money. Modern ultrasonic inspection techniques can cut the cost of such surveys to less than 15 percent of the older methods.

The application of ultrasonics to inspection and measurement problems in the pipe line industry has increased rapidly during the past few years. One of the most important applications is that of measuring thickness of steel plates when there is access to only one side, such as the sides of a storage tank filled with product, or the outside of an operating pipe line. Other more recent applications include internal flaw detection in shafts and engine parts, testing of welded seams in storage tanks, and powerful ultrasonic generators for efficient cleaning, emulsification etc.

How Ultrasonic Instruments Work! High frequency pressure waves (termed "ultrasonic" or "ultrasound") are beamed into the material from one surface by a transducer. They travel through the material at a constant velocity, are reflected at the opposite surface, and travel back to the transducer. Velocity of the waves through a given material is, for all practical purposes, constant, so the time required for a wave to make the round trip is a function of the distance traversed. In this case it is equal to twice the thickness. Thus, with a suitable means at measuring travel time, the thickness can be determined.

Inspection of Tank Plates Shows Savings. A recent internal corrosion survey conducted at Baton Rouge, Louisiana, is a typical example of audible indication ultrasonic metal thickness surveys in pipe line operation. Seven refined product storage tanks, ranging in size from 35,000 to 80,000 bbl. capacity, were inspected. Metal thickness measurements were made on the walls and roofs of five tanks containing gasoline, diesel fuel, or kerosine. Measurements were made on the walls, roof, and bottom of an empty tank, and on the bottom plates only in another empty tank, too. A total of 556 thickness readings were obtained, for a total cost of $734.93. This cost includes charges for the test engineer and ultrasonic equipment, his transportation and expenses, and additional equipment and personnel necessary for access to the sides of the tanks above ground level. Except for the measurement on bottom plates in the two empty tanks, all readings were taken from outside the tanks.

Measurements Made in Regular Pattern. Plates in each "ring" of the tank were 8 feet wide, with six rings per tank (in five of the tanks), making a tank height of about 48 feet. Three measurements were taken on each plate, 6 inches above the bottom edge, at the center, and 6 inches below the top edge. All test points were on vertical lines down the north, east, south, and west sides of the tank, making a total of 72 thickness measurements on the walls of tanks with six "rings." In addition, 20 readings were taken on each tank roof at carefully designated locations. In tanks having "pontoon roofs," readings were taken inside the pontoons as

well as on other sections. Locations were carefully designated by measurements from convenient seams etc., so that future readings can be taken in identical locations. Whenever signals indicated that the surface opposite the transducer was corroded or pitted, such information was recorded.

A "bosun's chair" was used to move the test engineer up the approximately 48 feet sides of each tank. A rope "block and tackle" was attached to the top of the tank, the bosun's chair secured to the lower end, and the test engineer together with his equipment, raised or lowered by an assistant on the ground. Fortunately, the paint on the tanks was smooth and had good ultrasonic properties, so accurate readings were obtained without the necessity of removing paint.

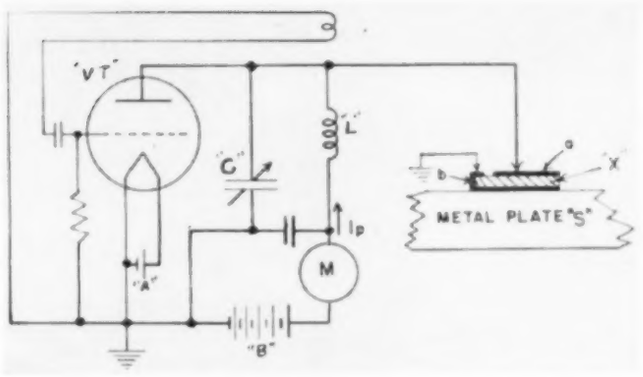


FIGURE 2—Circuit for thickness gage operating on the ultrasonic resonance principle. The high frequency pressure wave is produced by the transducer held against the metal plate.

Future Tests at Same Points Will Give Corrosion Rate. Data obtained on one of the tanks are shown in Table 1. This tank was constructed in 1941, and is presently used for diesel fuel storage. Exact original thickness of these plates is unknown, and therefore, corrosion rates cannot be determined. A minimum thickness was specified when the tank was constructed, however, and general conclusions can be made by comparing this information with present measured thickness. Future measurements at identical locations are planned, and will be compared with present readings to determine corrosion rates.

It is interesting to note that in practically every case, plate thickness in the center is greater than at either edge. This condition, known as "camber" was probably present in the original plates, and is almost always encountered when precision thickness measurements are made. When the plates are rolled from a steel billet, slight deflection in the rolls, etc., usually produce this condition. It may be assumed that minimum specified thickness is maintained near the edge of the plate. Maximum permissible "camber" tolerances are specified by the American Iron and Steel Institute, as is variation from specified plate thickness. For example, permissible minimum thickness of a plate .250 inch in thickness and 8 feet in width is .240 inch, or .010 inch under, and permissible maximum thickness is 12 percent over, expressed as a percentage of average nominal weight in pounds per square foot.

Inspection Detects Corrosion and Pitting. Analysis of ultrasonic signal strength and width indicated slightly pitted surfaces and scale in some of the tanks. Another interesting point was that apparently corrosion in a majority of the tanks occurred most frequently on the north and east sides. This cannot be definitely proved now, since original thicknesses are unknown.

Exposed Pipe Line River Crossing Inspected Quickly. Other surveys have been made on pipe lines, either by taking readings at "bell holes" or at exposed locations such as "river crossings." In one particular case, detailed thickness surveys were made at several exposed pipe line "river crossings," without removing the line from service. The pipe had been exposed to the elements over a number of years, and external corrosion was evident. Since the surface to which the transducer was to be applied was pitted, it was necessary to smooth it with a "disk sander." A portion of the data obtained in this survey is shown in Table II.

In another test, a detailed survey was made of the bottom plates of a 100,000-barrel oil storage tank. The tank was emptied and readings were taken on 2-foot centers throughout the bottom. In areas where thickness was reduced, or pitting on the unseen underside indicated, a more detailed survey was made.

TABLE 1—Thickness Measurements of Walls and Roof of Diesel Fuel Storage Tank*

SIZE WALL MEASUREMENTS							ROOF MEASUREMENTS		
Plate	Min. Original Thickness Spec.	Point	Present Measured Thickness North	East	South	West	Point	Min. Original Thickness Spec.	Present Measured Thickness
1 (Top Plate)	.242"	1 (Top)	.250"	.242"	.250"	.255"	1	.178"	.195"
		2 (Center)	.281	.265	.271	.279	2	.178"	.182"
		3 (Bottom)	.265	.242	.252	.268	3	.178"	.179"
							4	.178"	.178"
2	.242"	4	.258	.240	.258	.240	5	.178"	.180"
		5	.271	.258	.278	.259	6	.178"	.173"
		6	.254	.244	.258	.242	7	.178"	.173"
							8	.178"	.173"
3	.292"	7	.310	.281	.297	.311	9	.178"	.172"
		8	.322	.300	.322	.331	10	.178"	.173"
		9	.301	.278	.302	.314	11	.178"	.172"
							12	.178"	.173"
4	.394"	10	.387	.382	.378	.402	13	.178"	.174"
		11	.407	.407	.389	.421	14	.178"	.190"
		12	.390	.384	.378	.409	15	.178"	.175"
							16	.178"	.171"
5	.497"	13	.507	.499	.499	.491	17	.178"	.185"
		14	.518	.507	.501	.499	18	.178"	.175"
		15	.512	.496	.499	.493	19	.178"	.174"
							20	.178"	.175"
6 (Bottom Plate)	.602"	16	.595	.648	.604	.603			
		17	.606	.665	.621	.610			
		18	.600	.651	.611	.603			

* Thickness data obtained on a diesel fuel storage tank at Baton Rouge, La., August 15, 1955. Courtesy of Plantation Pipe Line Company, Atlanta, Georgia.

TABLE 2

Thickness Reading Taken on Gas Pipe Line

(Original specified wall thickness .3125 inch; pipe was exposed at river crossing.)

Distance from Zero Reference	Measured Thickness Degrees Counterclockwise From Top of Pipe as Viewed Looking South			
	0°	90°	180°	270°
10 feet South	.284*	.312*	.310*	.300*
8 feet South	.300	.310	.305	.307
6 feet South	.297	.288	.309	.292
4 feet South	.296	.268	.309	.302
2 feet South	.285	.251	.285	.286
1 inch South	.220	.236	.290	.270
1 inch North	.262	.270	.305	.285
2 feet North	.286	.307	.305	.310
4 feet North	.229	.310	.305	.310
6 feet North	.241	.310	.295	.312
8 feet North	.263	.303	.317	.319
10 feet North	.317	.313	.322	.326

Visible Indication Equipment Has High Accuracy for Station Work. Although visible indication ultrasonic equipment is primarily designed for semi-portable applications, it gave good results on a survey of pipe thickness in a pump station. Original thickness of station piping and headers was unknown, and a large number of readings was required to establish safety limits. The gage was set up near the center of the station, and a 50-foot extension cable used from the instrument to the oscillator and transducer. In this manner many readings were made quickly. In some cases, continuous readings were taken around the circumference of the piping. This type of equipment makes practical such continuous thickness readings.

How to Use Audible Indication Ultrasonic Instruments. One of the ultrasonic instruments particularly adapted to thickness measurement of pipe lines and storage tanks is shown in Figure 1. This instrument is portable, battery operated so that no power line is required, and is usually carried by a shoulder harness. It weighs about 13 pounds. Thickness range of the standard equipment used on pipe line applications is .058 inch to about 10 inches in steel. Special equipment permits measurement down to about .015 inch in steel.

The basic components of this equipment is illustrated in Figure 2. It consists essentially of a high-frequency electronic oscillator, a quartz crystal "transducer" to convert electrical energy from the oscillator into mechanical pressure waves, and vice-versa, and a means of measuring elapsed time.

Thickness Calculations Can Be Made Quickly. Time interval between successive recurrences of an oscillating frequency is used as a convenient measure of time. The relationship between thickness, velocity, and frequency, is expressed by the following:

$$T = \frac{V}{2f} \qquad (1)$$

Where:

T = Thickness in inches

V = Velocity of the sound wave in the material under test in inches per second.

f = Fundamental frequency in cycles per second.

In order to increase the thickness range above that corresponding to the frequency range of the oscillator, harmonics, or "multiples" of the fundamental frequency, can be used. In this case, $f = f_n - f_{(n-1)}$, where f_n is the nth harmonic, and $f_{(n-1)}$ is the next lower harmonic. Substitution in the above equation then provides the following:

$$T = \frac{V}{2(f_n - f_{(n-1)})} \qquad (2)$$

In actual operation, the "resonant" frequency, or harmonics thereof, whose time interval is equal to the travel time required for the particular thickness involved, is determined by manually adjusting the tuning knob to a point where a wave is propagated from the transducer at exactly the same instant that the previously transmitted wave has arrived back at the transducer. A wave interference, or "resonance" condition is then set up, and the power required to drive the oscillator is increased. The fundamental or resonant frequencies are then recorded, and converted to thickness either by a conversion scale on the instrument or by using Equation 2. Higher accuracy and reliability are obtained when the operator uses a slide rule to establish the authenticity of these frequencies (when using harmonics, as is usually the case), and then calculates thickness.

Analysis of Signals Shows Surface Condition. The signal strength or amplitude of "resonance peaks" is high when measuring materials with a uniform thickness, and therefore, a good reflecting surface opposite the 1½ square inch area of the transducer. It is reduced and broadened when the reflecting surface opposite the crystal search unit or transducer is rough and pitted, since there is an exact resonance frequency applicable to each different thickness under the 1⅜-inch crystal diameter. Figure 3 illustrates these conditions.

A skilled operator is able to select the approximate center of this resonance band, and therefore, an average thickness approximately midway between the "peaks and valleys," is obtained. A qualitative analysis of the condition of the unseen reflecting surface can be obtained if other factors, such as scale, are comparable. Signals are classified as "good," "medium," or "poor," on the original data sheets. The "good" signal indicates a uniform opposite surface, the "medium" usually a slightly pitted surface, and "poor" a badly corroded surface.

In addition to the effect that rough and pitted surfaces have in the reduction of signal strength, it is also possible to reach a point where thickness variation under the 1⅜-inch crystal diameter is so great that resonance peaks will blend together, and no definite signals can be obtained. In general, when the "peak-to-valley" depth of pitting under the transducer exceeds 20 percent of the total thickness, or if it exceeds one-half wave length (approximately ⅛ inch in

About the Author

DWIGHT J. EVANS has a wealth of experience in engineering testing and inspection. Following graduation from the University of Kansas with a degree in electrical engineering in 1938, he joined the Engineering Test Division of Phillips Petroleum Company. During World War II he served three years in the U. S. Navy as a radar officer. After the War he returned to Phillips before joining Branson Instruments, Inc., engineering staff in 1948. He formed Engineering Test Services, Inc., in early 1950, specializing in ultrasonic testing, equipment sales engineering, and experimental stress analysis.

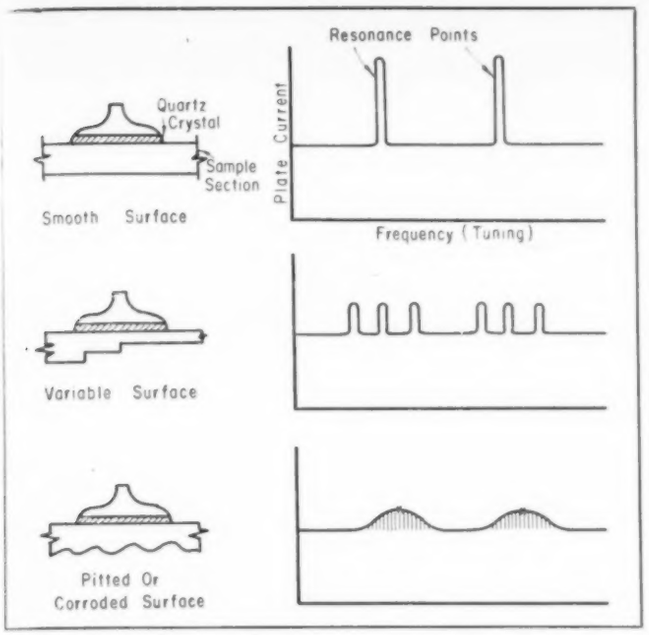


FIGURE 3—Signal strength of resonance peaks show condition of the metal reflecting surface. A skilled operator can evaluate metal condition from the pattern.

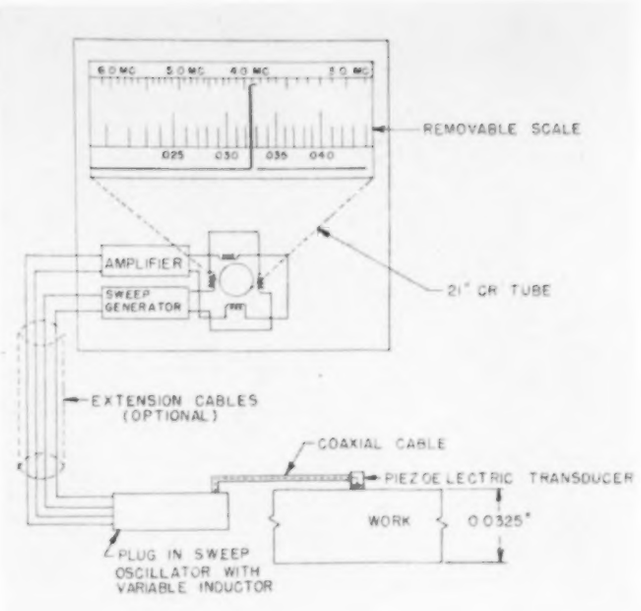


FIGURE 4—Block diagram of visible indication ultrasonic equipment. Direct reading scales permit accuracies to within ¼ percent of metal thickness.

steel at one megacycle), it will be impossible to measure thickness. In such cases, this condition is recorded, and the transducer moved a few inches until a definite resonance can be obtained.

Skilled Operator Can Get Results Within ± 1 Percent of Metal Thickness. Accuracy is not appreciably affected by liquids or deposits such as coke or scale, on the opposite side of the plate, although signal strength will be reduced when such conditions are encountered. A portion of the sound waves are reflected and a portion refracted at interfacial surfaces separating two materials that have different acoustical impedance, (product of velocity and density), such as steel and water, or steel and scale. The amount of reflected energy, and therefore, signal strength, is proportional to the difference in acoustical impedance.

A skilled operator using a slide rule to check resonance points and calculate thickness can get accuracies within ±1 percent. The ability of the instrument operator to select the central point of the broad resonance peak obtained when material is pitted or corroded is a determining factor in obtaining these accuracies. These results make possible the determination of annual corrosion rates, effectiveness of corrosion control systems, etc.

Since the amplitude of vibration of the quartz crystal is microscopic, the crystal must be in intimate contact with the metal surface to which it is applied. A coupling medium between the quartz and steel plate, such as soil or glycerine, must be used to fill any surface cavities, etc. Waves cannot be transmitted through scale and only very rarely through paint. Therefore, if the metal surface to which the crystal is applied is corroded, it must be completely scaled, and any roughness removed by a "disk sander." In general, about one-half of the surface under the 1⅜-inch diameter transducer must be clean, bright, and "flat."

Visible Indication Equipment Best Suited For Station Tests. Equipment shown in Figure 4 utilizes the basic theory of the audible indication equipment, except that frequency sweep is done electronically and tuning, therefore, is automatic. The "frequency-power" curve is displayed on a 21-inch cathode ray tube, and resonance points are shown as vertical lines on the tube face. Direct reading scales, calibrated in thickness corresponding to the proper frequency, as determined from Equation 1, are inserted over the tube face. Each calibrated scale covers a limited thickness range, such as .220-inch to .500-inch, and are quickly interchangeable with other ranges. Total range is from about .006-inch to 2.5-inch. Greater thicknesses can be measured by calculation. Accuracy is on the order of ±¼ of 1 percent on materials with a uniform thickness.

The visual instrument enables the operator to rapidly obtain a large number of continuous readings on equipment such as station piping, pressure vessels, etc. It is not readily portable as is the audio instrument, and requires a 110 volt AC power supply. However, an extension cable up to 1000 feet in length can be used between the instrument and the transducer. It is used when a large number of readings, or a detailed survey, is made at one location.

Ultrasonic equipment, either audible or visible, when used by a trained operator, provides a practical field method of obtaining large numbers of thickness readings at a comparatively low cost. Classification of signal strength enables trained personnel to qualitatively analyze the condition of the opposite surface, as to degree of pitting, etc., provided that other variables, such as surface and transducer contact, are relatively uniform. Accuracy obtained by personnel trained in use of this equipment is on the order of ± 1 percent, thereby providing a means of establishing safety limits and making possible determination of corrosion rates exceeding a few mils per year.

ACKNOWLEDGMENT

The author expresses his appreciation to Dr. Ivy Parker, Plantation Pipe Line Company, for her assistance in furnishing part of the data used in this article.

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Line walking by helicopter has proved a definite advantage to Hope Natural Gas which had some rugged terrain and weather conditions to cope with on its West Virginia pipe line. 'Copters, equipped with pontoons, have already proven valuable to pipeliners in the marshes of South Louisiana.

Line 'Walking' by Helicopter

Aerial inspection of pipe line rights-of-way has a new wrinkle. Helicopters are doing the job for Hope Natural Gas where conventional aircraft were not suitable.

Heavy wooded sections such as this don't deter the helicopter inspectors, who patrol up to 170 miles of pipe line per day.

LINE WALKING is not what it used to be. At least not for Hope Natural Gas Company inspectors, who have taken to the air in helicopters for quicker, more efficient right-of-way inspection.

Terrain and weather conditions underfoot once made the mountain line walker's life tough, but they are no strain for Hope's flying inspectors. In addition to inspection, this airborne crew does double duty on special jobs such as: patrolling segments of a line during high-pressure deadweight testing; controlling gate valves at remote points; furnishing a high speed "taxi" service for supervisory personnel and repair crews; transporting sick or injured from an isolated or disaster area; making aerial surveys; checking company communication lines for possible damage, and taking aerial photographs.

The "whirlybird" is ideally suited to follow the contours of the rough terrain in West Virginia at low altitude. Flying at a ground speed of 35 to 40 miles per hour, Hope's 'copter crew covers an average of about 170 miles of line per day. They work a

normal five-day week, except in inclement weather. Then, if necessary, they make up lost flying time on weekends.

Skimming about 40 to 60 feet from the ground, the pilot and observer have a clear view through the plastic bubble to detect leaks, landslides and any other conditions of an unusual nature. When a leak is detected by discoloration of the ground and vegetation, or other trouble is sighted, a landing is made to permit closer inspection. This is one big advantage of the helicopter over the faster but less versatile airplane.

If a landing is not possible, a sandbag with a yellow streamer attached is dropped to mark the spot and a radio report is made to the proper division headquarters. Two-way radio contact is maintained at points of departure, points of arrival, and various Hope control stations or mobile units at approximately 30-minute intervals while in flight.

Hope contracted for helicopter service on a trial basis with the Pipeline Construction and Drilling Company of Camp Hill, Pa., in October of 1955. Production Engineer Bernard Berry, a former bomber pilot during World War II, was assigned as observer during the 60-day experimental period.

At the end of the first trial period, Berry and Pilot George Reno had inspected 7558 miles of right-of-way in 139 hours flying time. Their accomplishments in finding leaks and performing other services were evaluated, and Hope decided to try the helicopter inspection for an additional year. Pipeline Construction now has three helicopters in service for gas line inspection.

George Reno, who is serving as Hope's inspection pilot, is also supervising Pipeline Construction's helicopter venture. He is a veteran of ten years' service with the Navy. Later, as a civilian, he flew as an airline pilot from 1947 through 1953. At that time he joined the construction firm and started flying helicopters in 1955. He has been with them since.

After Hope's helicopter inspection crews completed 9420 miles of right-of-way inspection in 217 hours and 25 minutes flying time, the company was well satisfied with this method of inspection. It looks like the answer to mountain pipe line inspection.

—The End

A foot and a half of snow didn't make the line walker's job any more pleasant. Here is a typical winter scene that points out the advantages of aerial inspection.

This is the terrain that made inspection a rugged job on Hope's West Virginia pipe line. 'Copter crews now inspect ten times as much line per day as the walker did.

Side view of maintenance gang truck showing tool compartments and oil field bed. Note high position of turn indicators—makes them more conspicuous and less vulnerable to road spray.

In Pipe Line Maintenance . . .

Six Keys to "Vehicle" Safety

Great Lakes Pipe Line has reduced automotive accidents by creating proper driver attitude and establishing a workable vehicle maintenance program.

By L. J. JAMES
Great Lakes Pipe Line Company
Kansas City, Missouri

YOUR COMPANY can cut automotive accidents to a minimum—*if* you will concentrate on creating proper driver attitude and vehicle maintenance. Accomplishment of both these goals will be easy if you include the following six "keys" to safety in your program:

1. Give the driver a voice in all your safety plans.

2. Modify equipment to meet your own special needs.

3. Provide rugged patrol equipment.

4. Make vehicle maintenance responsibility definite and personal.

5. Inspect vehicles regularly.

6. Keep drivers informed about vehicle costs.

1. The Driver. Driver attitude can be influenced favorably through a sound program of proper vehicle selection, maintenance and upkeep.

In selecting vehicles for a particular service always give careful consideration to recommendations of both the driver and his supervisor—the terrain to be covered—the type of operations to be performed.

Within reasonable limits, provide the type and make of vehicle preferred. It is logical that the driver will take greater pride in his equipment if he has some voice in its selection. Proper respect and care for equipment lead to safety in pipe line maintenance work.

Both the drivers and others who work with automotive equipment must be convinced that management is sincere about vehicle safety.

2. Modify Your Equipment. Two-ton trucks with oil field beds and power winches should be outfitted with necessary equipment to handle pipe line maintenance efficiently and safely. Here are some successful safety ideas adopted by Great Lakes maintenance crews:

• **Remove winch controls from the floor board and install them on the dash** to make them more accessible, easier to handle—and to provide more space in the cab. Controls should be positive acting and move in the same direction for best coordination. This reduces greatly the chance for error resulting from confusion.

• **Rollers on the rear of truck beds can be removed** without sacrificing efficiency of operation. This not only reduces weight but also removes a slipping hazard.

• **Electrically operated brake locks installed on the regular braking system of gang trucks** make it possible to lock all four wheels for winching and other backfilling operations.

3. Make Patrol Equipment Rugged. Employes working line patrols should be provided equipment that will permit them to do their job with complete safety. At Great Lakes, accidents have been reduced by equipping all patrol trucks with:

• Bodies specially constructed to store maintenance tools and equipment properly.

• Nylon tires to withstand tough road hazards. The company has not experienced a blowout or carcass failure since we started using this type of tire.

• Six-inch turn indicator lights mounted in a high position to make them conspicuous—and less vulnerable to road spray. The same type of mounting should be used on gang trucks, or other vehicles which enter and leave main thoroughfares in the course of the job.

4. Personalized Maintenance Responsibility. Wherever practical the responsibility of maintaining each vehicle should be assigned to one person. This pays safety dividends through greater care in handling and maintaining the vehicles.

At Great Lakes, the driver can spend up to $100 without special approval, for the purpose of obtaining needed repairs or maintenance items. This authority encourages every driver to correct improper conditions without delay.

5. Make Periodic Inspections. The supervisor of motor transportation should inspect all vehicles at least four times a year. On these visits he checks the performance and condition

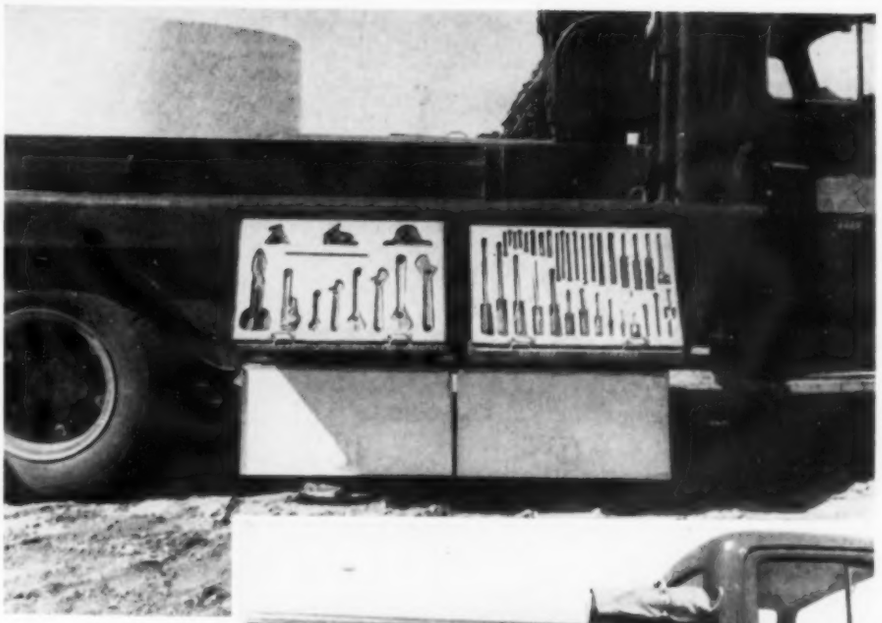
of the vehicle in the presence of the driver and at the same time discusses any suggestions or problems which might arise.

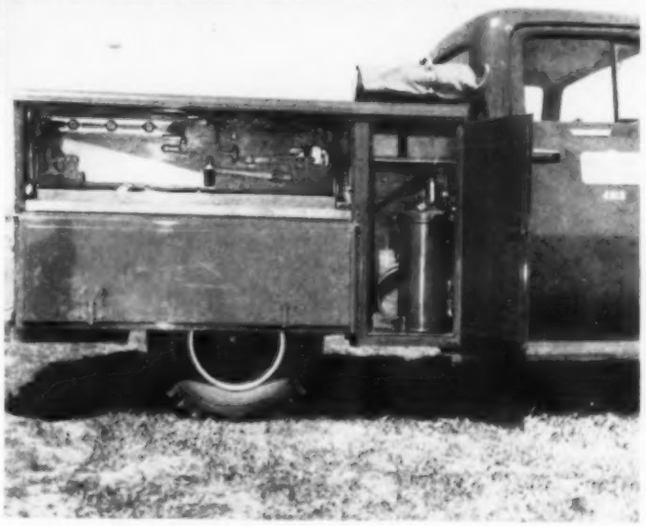
A written report covering the results of the inspection should be made —and signed by the driver. Copies of the report are furnished to the driver, the area or departmental office and the general office. This is primarily intended to be constructive—not a policing measure.

Even so, the driver knows that these periodic but unscheduled inspections are coming, and thus strives to operate and care for his vehicle according to established practices.

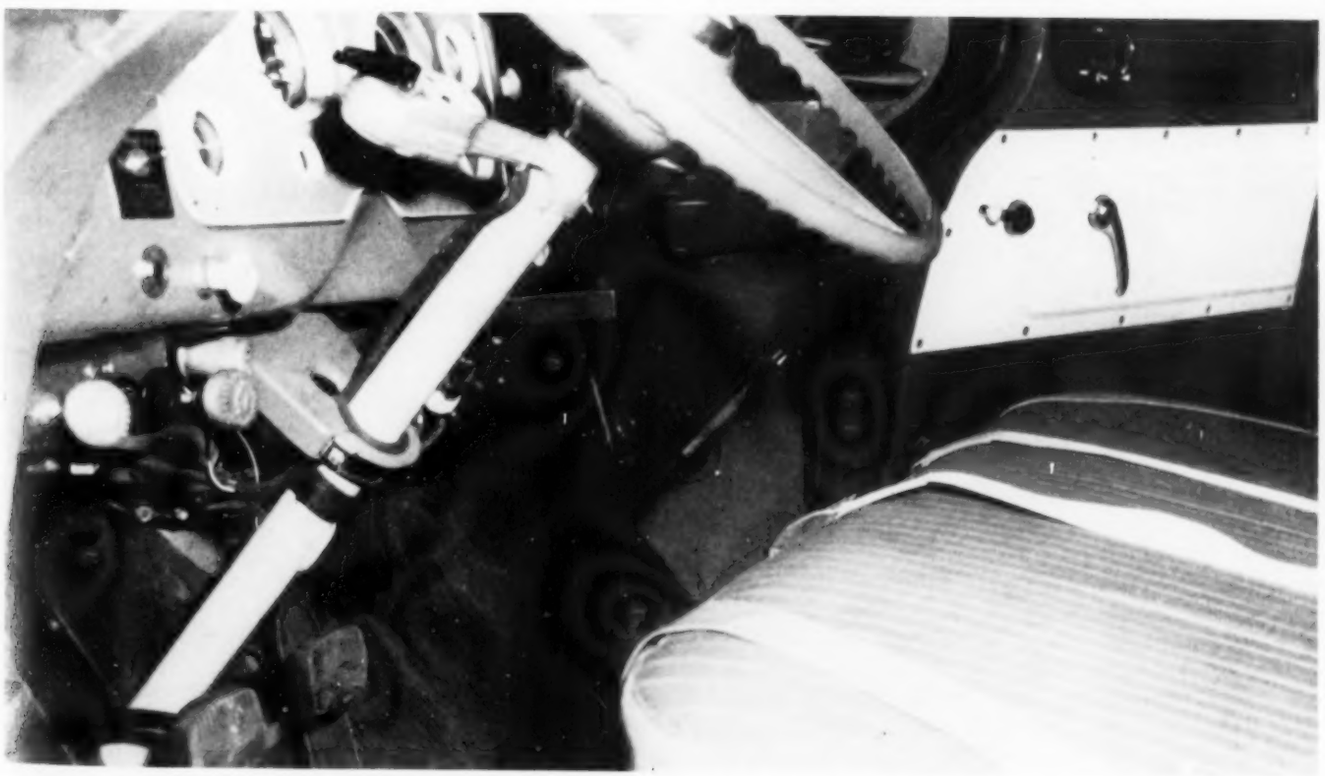
6. Circulate Your Cost Reports. Cost reports should be published every six months. They should include cost per mile for gasoline, lubricants, depreciation, repairs and maintenance on each vehicle. The driver is thus informed as to how his expenses compare with other drivers who are responsible for and are operating similar equipment. Unusually high costs many times indicate abuse of equipment and unsafe driving practices.

The six "keys" to safety outlined above—if employed properly—will reduce vehicle accidents to a minimum. Great Lakes' low accident record proves it. —**The End**



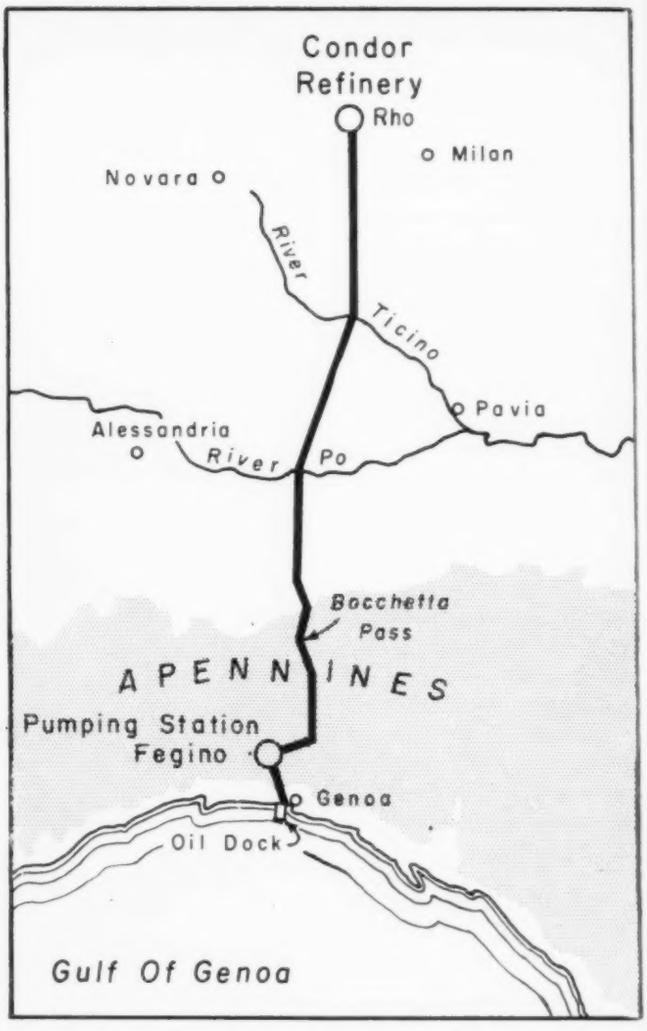


Tool drawers on Great Lakes maintenance gang and patrol trucks are installed inside compartments so proper tools will be readily available for use. Note fire extinguisher strapped to top of line patrol truck.



Electrically operated brake lock switch and winch controls are shown at upper left. Moving winch controls to dash makes them more accessible, easier to handle and clears the floor area of the truck.

Condor's 87-mile 12¾-inch Italian pipe line crosses some rugged terrain in ascending the Apennine Mountains to Bocchetta Pass, 2800 feet above the pump station.



Italy's first major pipe line moves foreign shipments of crude oil from the port of Genoa to Milan area. It can pump 15 million barrels of crude a year.

Italian Pipe Line Crosses Apennines

Fourteen million barrels of crude a year to be moved from port at Genoa to industrial center at Milan. Pipe line rises 2800 feet from docks to top of Bocchetta Pass, spanning two major rivers before it enters refinery at Rho.

COMPLETION OF the 87-mile pipe line from the Italian port of Genoa to Milan has opened that highly industrialized area to direct shipments of crude oil from foreign ports. Condor Societa per Azioni per l'Industria Petrolifera a Chimica constructed the line which can move about 14 million barrels of crude oil per year from the new docks at Genoa, over the Apennine Mountains, to its refinery at Rho.

To keep the refinery supplied with crude oil by road would have meant employing a huge fleet of about 150 tank trucks to make the round trip each day from seaport to refinery.

Incoming tankers with crude oil for the refinery berth at the new petroleum dock within the port of Genoa. The dock, built for the Port Authority by Condor, has facilities for berthing tankers up to 30,000 tons.

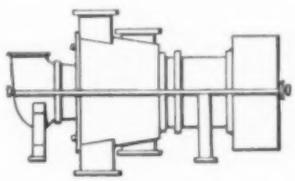
Tankers normally unload at a rate of about 3500 barrels per hour. The 12-inch pipe line pumps only 840 barrels per hour, so tank storage capacity was provided at Genoa to maintain optimum flow of oil through the main line. This tank farm, located two and a half miles from the harbor, is connected to the unloading pier by two 16-inch pipe lines, with a booster pump station at the end of the pier. Six floating roof type steel tanks provide a total storage of half a million barrels.

Oil Moves From Port Over 2800-Foot Pass. The pipe line to Milan

Westinghouse 5000-hp gas turbine

gives you the reliability you want

The mechanical simplicity and conservative design of Westinghouse turbines give you the reliability you expect and want in pipeline service. • The complete absence of sliding motion reduces friction and wear to an absolute minimum. • There is no cooling water system required. • Permanent alignment is assured by turbine's rigid construction — no bedplate is needed. • The highly precise hydraulic governing system has been proved on millions of horsepower of steam turbines.

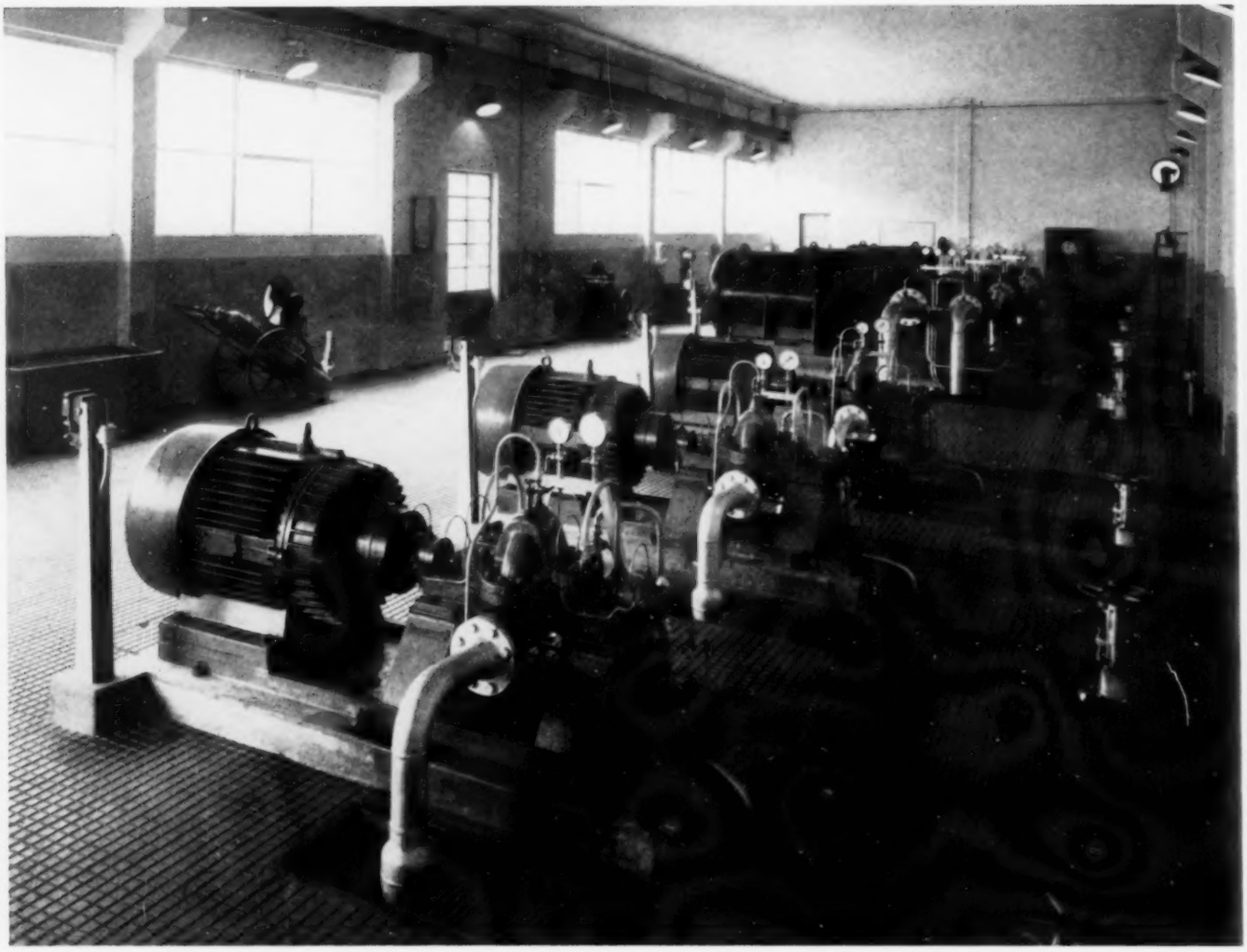


For more information, see your Westinghouse sales engineer, or write for booklet DB-1515 to Westinghouse Electric Corporation, 3 Gateway Center, Pittsburgh 30, Pa. J-50590

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

5000-hp gas turbine with cover removed.



Main line pump station located at Genoa (Fegino) is equipped with three electrically-driven centrifugal pumps, each having a capacity of 53,000 gallons per hour against a head of about 1700 psi. Crude oil is pumped from the storage tank farm at Genoa to the refinery at Rho.

climbs 2800 feet over the Bocchetta Pass. It is made up of a single 12¾-inch line of seamless, electrically welded construction. Beyond the mountain pass, the line crosses the plains of Lombardy, a fertile agricultural area.

The pipe line crosses two rivers, the Ticino and the Po. To avoid damage from spring floods so common in northern Italy, the line was suspended about 50 feet above the Ticino river bed. At the Po crossing, the pipe was supported immediately below the roadway of an existing road and rail bridge.

Three Pumps Move Oil Across Apennines. The oil is pumped through the line by three electrically driven centrifugal pumps. Each pump has a capacity of 53,000 gallons per hour against a head of about 1700 pounds per square inch.

Determination of the power capacity of the pumps was affected not only by the basic problem of lifting oil against the static head, but also by the wide variation in viscosity due to the temperature differential encountered in crossing the mountains. Pumping temperatures vary from 42° F. to 82° F.

Corrosion Protection Provided. Before each section of pipe was laid, it was coated with asphalt and glass fiber. It was not possible to adopt entirely American construction methods of continuous ditching, wrapping and laying, because of the terrain. In fact, a large part of the trench was dug by hand.

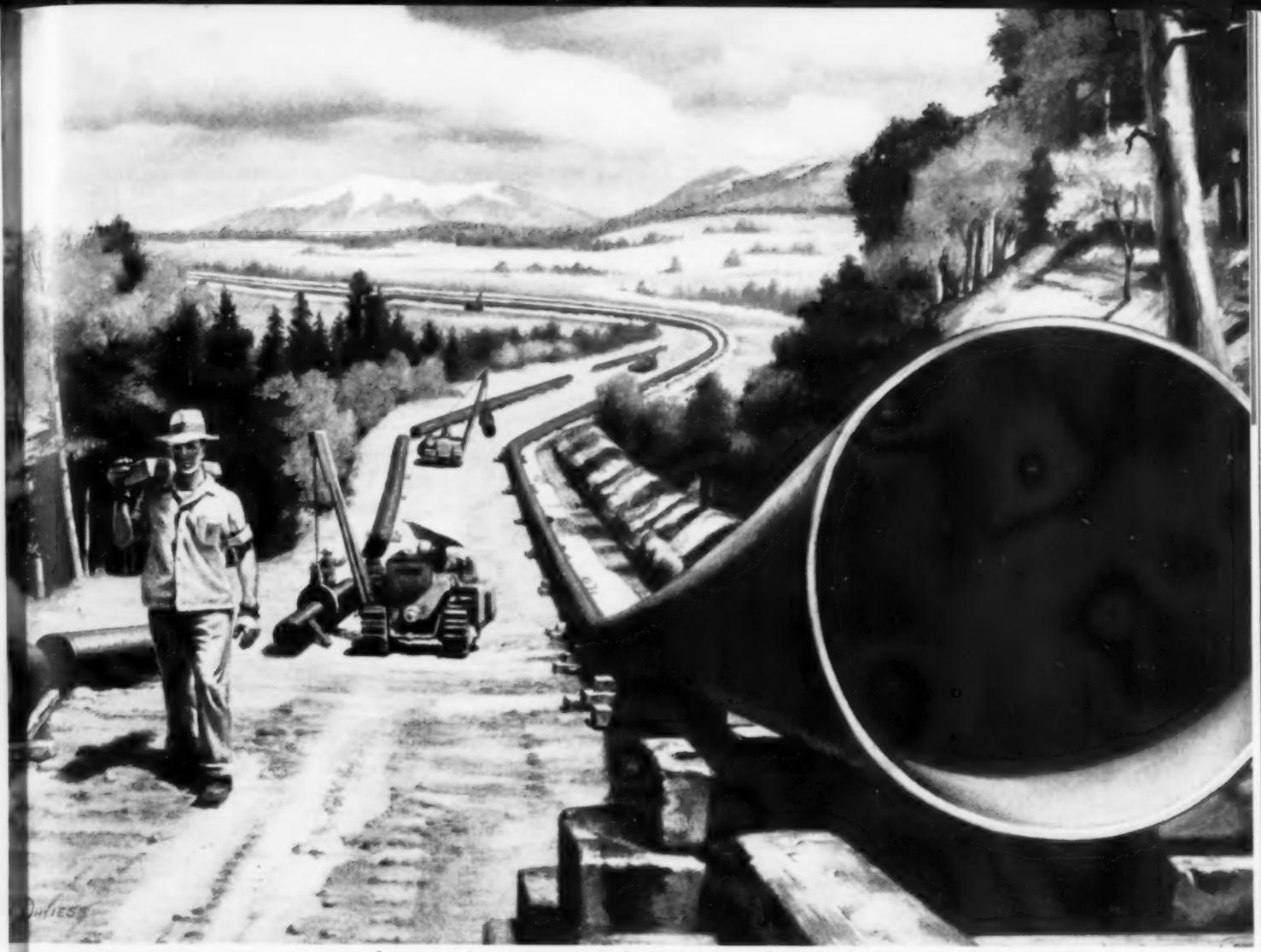
Short Wave Radio Communications Established. A short-wave radio link-up was established between the tank farm at Fegino and the refinery at Rho. The Apennine range interferes with direct contact between the two points; so an automatic repeater station was built at the highest point of Bocchetta Pass.

Italian Line May Stimulate More European Pipe Lines. The Italian pipe line expedites the delivery of refined petroleum products to all the important industrial towns of northern Italy. The refinery at Rho is six miles from Milan, the center of the most intensely industrialized area of Italy and an area that accounts for about 60 percent of the national consumption of petroleum products.

Pipelining is comparatively new in Italy. The success of Condor's new crude oil line, however, points to wider use of oil pipe lines on the European continent.

Condor already expects to step up the annual capacity of its line to 2 million gallons by the installation of an additional pump station.

—The End



Transcontinental pipelines are among the many places where Cathodic Protection and Anaconda Type CP Cable are used to check corrosion.

Cable that helps make the pipeline a good neighbor

To make cathodic protection systems more economical and effective – to help pipeline and oil companies check costly corrosion, stop leaks, make pipelines good neighbors – Anaconda offers a special Type CP Cable that *lasts far longer* on the job than ordinary cable.

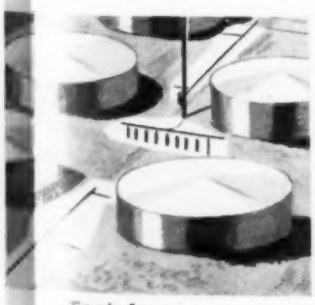
High-grade polyethylene insulation and tough Densheath* (PVC) jacket offer high resistance to electroendosmosis†, as well as high resistance to oil, moisture, and most acids, alkalies and chemicals found in corrosive areas. And rugged Densheath withstands toughest abrasion, moisture, sunlight and weathering.

For special applications, a one-layer insulation and jacket construction of polyethylene is available.

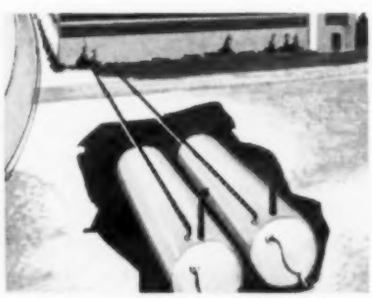
To order, or for more information—call the Man from Anaconda. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

*Reg. U.S. Pat. Office †Cable failure on direct current in wet locations 56357 Rev.

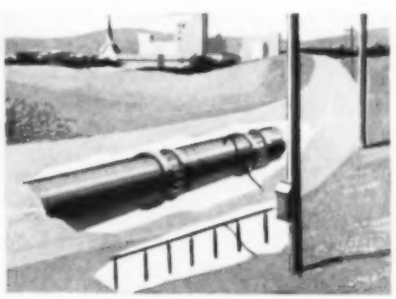
WHERE ANACONDA TYPE CP CABLE AND CATHODIC PROTECTION CUT CORROSION COSTS



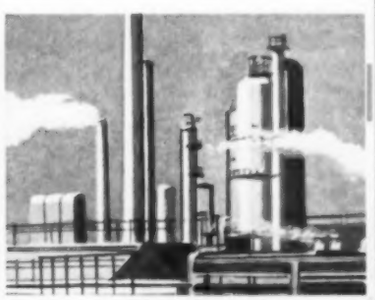
Tank farms



Underground storage tanks



Pipelines



Oil refineries

ASK THE MAN FROM ANACONDA®

FOR CATHODIC PROTECTION CABLE

One hundred-foot hole, dug by bulldozer, is site for six wells drilled to supply water for drouth-stricken Hominy. At left is the pumping equipment and Service Pipe Line Company facilities loaned to Hominy for the emergency. Through the borrowed 8-inch pipe line, the city now is receiving 400,000 gallons of water a day.

Ellis Orr, right, Service Pipe Line Company district superintendent, Carlson, Oklahoma, and John Rader, mayor of Hominy, inspect water flowing into the city's settling pool. Hit by dwindling water supply, Rader asked the pipe line company to help fill its reservoir. The company turned an 8-inch pipe line over to the city.

Oklahoma Pipeliners Prove Good Neighbors

To drought-stricken Hominy, Oklahoma, loan of a section of 8-inch line meant an abundant summer supply of water.

DOWN TO A 30-day supply of water, a drouth-stricken town in Oklahoma appealed to a local pipe line company for aid. And it received vital aid when Service Pipe Line Company turned over a crude oil line to Hominy, Oklahoma, for use in pumping water from well sites near the Arkansas River.

John Rader, mayor of Hominy and a retired engineer with Service Pipe Line, quickly realized the possibilities of using one of the company's 8-inch lines to bring water to the town of 4000. His request to borrow the line was granted when Service learned that the company's operations could be continued without it.

This line section passed near the Arkansas River and also near the town's reservoir. After the crude oil was pumped from the line, its operation was turned over to the town of Hominy.

While the line was being cleared, six wells were drilled to a depth of 35 feet in an excavated area near the banks of the Arkansas River. A pump was borrowed and installed. Soon water was flowing from the pipe line into the Hominy reservoir.

Water usage had been drastically curtailed. Now, with 400,000 gallons of water being pumped into the town's reservoir daily, the townspeople have twice their daily requirement. Addition of another pump will raise the daily intake to 800,000 gallons a day and end the rationing of water in force since early summer.

Use of Service Pipe Line facilities is only a temporary measure, according to O. O. McKenzie, Shawnee (Oklahoma) division manager for Service. Hominy is presently letting bids for the construction of a dam expected to be completed by 1957. It will assure the town a two-year supply of water.

Once again pipeliners have proven to be good neighbors. —**The End**

Pumping Progress Report

FOR PIPE LINE ENGINEERS

An advertisement prepared by the Aldrich Pump Co., Member of Hydraulic Institute, U.S.A.

PUMP INSPECTION, MAINTENANCE AND REPAIR are jobs too frequently ignored in the design of production pumps. This has been verified by a survey of more than 15,000 pump installations. Speed and economy of maintenance was frequently quoted as a major factor in pump selection.

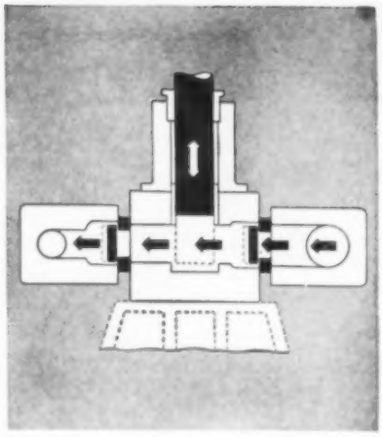
SECTIONALIZED FLUID-ENDS offer one of the best ways to guarantee both speed and economy in pump maintenance. As originated by ALDRICH Pump Co. Engineers, the Sectionalized Fluid-End comprises four main assemblies — the working barrel, suction manifold, discharge manifold and stuffing box.

SPEED IN MAINTENANCE is assured because of ease of accessibility of all wearing parts. Manifolds can be slid back on studs and valves removed as complete units. Split collar and flange connection of plunger to yoke permits easy removal of plunger.

ECONOMY OF MAINTENANCE results from speed in maintenance. Perhaps even more important is the simple fact that it is cheaper to replace a single section than a complete fluid-end. Another important economy is parts interchangeability. Among 3-, 5-, 7- and 9-plunger units of any series, wearing parts are interchangeable. Where a combination of multiplex pumps is required, this reduces spare parts stocks.

THE ALDRICH PUMP COMPANY is the originator of the DIRECT FLOW principle — a design innovation that utilizes the sectionalized fluid-end principle. Aldrich Engineers have become known as the people to take your tough pumping problems to. We have never turned down a challenge.

FURTHER INFORMATION can be had direct from the company. Tell us your problem and we'll send you Data Sheets describing the size pump we recommend to solve your problem. Address your request to: The Aldrich Pump Company, 6 Pine Street, Allentown, Pa. (Advertisement)



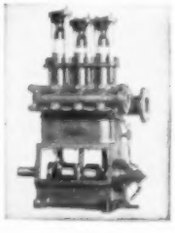
Aldrich Direct Flow Fluid-End Design

...for your tough pumping problems specify ALDRICH

The Direct Flow principle, an Aldrich design innovation, is a major forward step toward the solution of tough pumping problems of all kinds. Not only does it eliminate two right-angle turns in the fluid-end, but in addition makes possible complete Fluid-End Sectionalization. This is another Aldrich design innovation which permits economies of maintenance and repair offered by no other type pump.

CHECK THESE ADVANTAGES OF SECTIONALIZED FLUID-ENDS:

Less expensive parts replacement
Ease of inspection and maintenance
Interchangeable wearing parts
No special equipment for valve removal
Easily accessible stuffing boxes



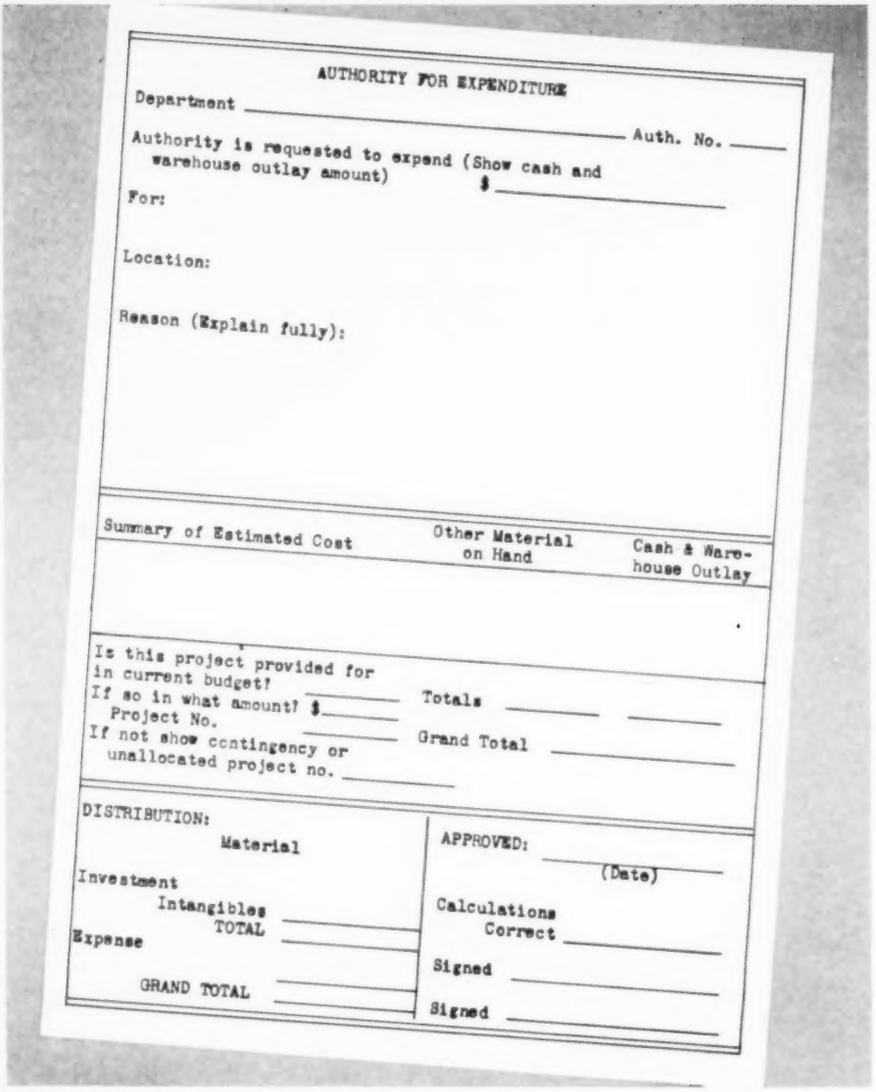
Write today for Data Sheets describing the Direct Flow Pump Series.

THE ALDRICH PUMP COMPANY

Originators of the Direct Flow Pump

6 PINE STREET
ALLENTOWN, PA.

Representatives in principal cities



AUTHORITY FOR EXPENDITURE

Department _____ Auth. No. _____

Authority is requested to expend (Show cash and warehouse outlay amount) $ _____

For:

Location:

Reason (Explain fully):

Summary of Estimated Cost	Other Material on Hand	Cash & Warehouse Outlay

Is this project provided for in current budget? _____ Totals _____ _____

If so in what amount? $_____ Project No. _____ Grand Total _____

If not show contingency or unallocated project no. _____

DISTRIBUTION:

Material

Investment

Intangibles _____

TOTAL _____

Expense

GRAND TOTAL _____

APPROVED: _____ (Date)

Calculations Correct _____

Signed _____

Signed _____

FIGURE 1—Sample form used by one of the surveyed pipe line companies to request authority for expenditures. Only after this form has been completed and signed can a project begin.

How to Plan and Control Capital Expenditures

Here is a revealing survey report on the way 15 oil companies plan and control capital expenditures.

Dr. G. E. KISER, Chairman
Department of Economics and Business Administration
Texas Western College, El Paso, Texas

SUCCESSFUL COMPLETION of a pipe line project—whether it be a new station or a pipe line loop—depends on the way two vital questions are answered.

1. Are the *plans* for capital expenditures sound?

2. Are the *controls* properly designed to administer the plan?

The following is a survey report on the way 15 oil companies plan and control capital expenditures. Property, plant and equipment spending for the selected group of companies total over $1 billion, or one-fourth of the oil industry's total expenditures in the U. S. (see Table 1). Here are the results of the survey.

TABLE 1
Gross Capital Expenditures of 15 Oil Companies That Were Surveyed

Company	(Million of Dollars) 1950	1951	1952	1953	Total
A	$ 86.7	$ 145.7	$ 206.1	$ 237.7	676.2
B	118.0	164.5	172.2	213.5	668.2
C	131.1	158.8	203.4	206.3	699.6
D	160.8	143.5	173.1	173.8	651.2
E	110.5	158.8	160.3	154.2	583.8
F	43.7	88.7	90.7	89.8	312.9
G	120.7	133.5	94.0	47.6	395.8
H	35.0	113.5	96.8	45.2	290.5
I	38.8	71.3	72.9	82.1	265.1
J	25.6	32.6	40.5	48.3	147.0
K	4.2	7.4	12.1	12.2	35.9
L	.9	1.0	1.5	1.7	5.1
M	.....	.....	.....	.....	.....
N	.....	.....	.....	.....	.....
O	.....	.....	.....	.....	.....
Total	876.0	1219.3	1323.6	1312.4	4731.3

(Information was not available on last three companies. They are relatively small companies with majority of the stock being held by one family.)

Planning Capital Expenditures

Five major aspects enter into planning capital equipment expenditures:

1. Capital Budget—Fourteen of the 15 oil companies surveyed construct a capital budget as the basic instrument of planning.

A capital budget covers the probable capital expenditures for the coming budget period, consolidated in such a way as to present the aggregate demand for capital funds and expressed in terms of specific individual assets which have moved up through the management hierarchy for supervisory review. This is an intellectual process, the conscious determination of a course of action based on purpose, facts, and considered estimates.

Two different systems are used in preparing the capital budget:

1. Top management compiles the information supplied from the "grass roots" of the company. Wide participation by employes at all levels in the organization is emphasized. The person closest to the daily operational needs of the enterprise is assumed to be aware of those expenditures that will make his individual efforts most rewarding. Each proposal is screened and translated into an estimate of over-all capital needs. Twelve of the 15 respondents use this system.

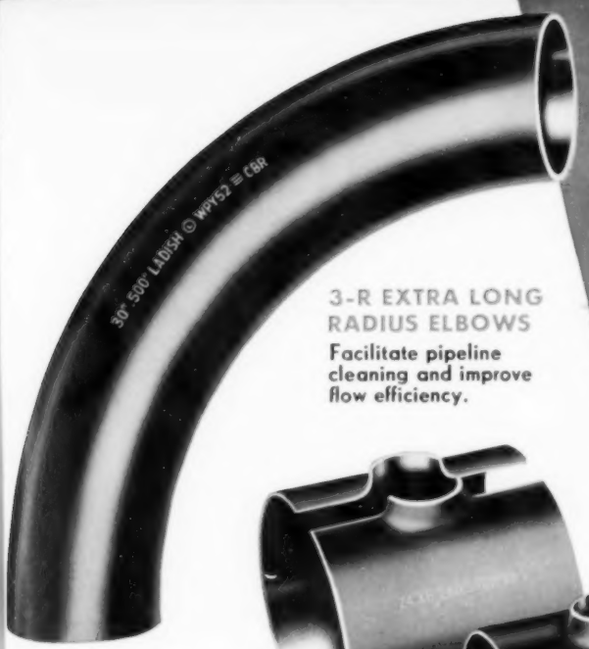
2. In two companies top management states in general terms the capital spending authorized in each operating area of the company. This pronouncement of policy is issued annually and is the result of the best

LADISH

Developments

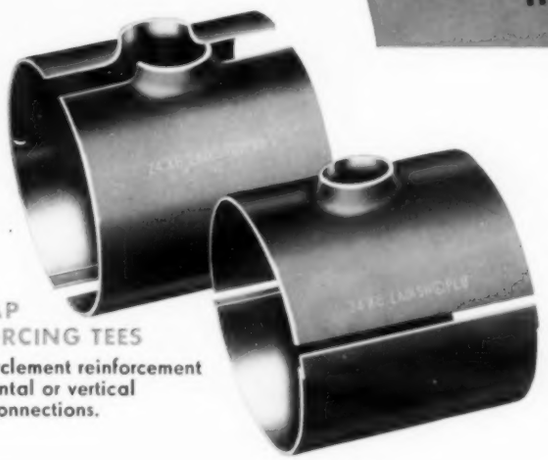
FOR THE PIPE LINE INDUSTRY

SPECIAL FITTINGS SOLVE INDUSTRY'S PIPING PROBLEMS



3-R EXTRA LONG RADIUS ELBOWS

Facilitate pipeline cleaning and improve flow efficiency.



HOT TAP REINFORCING TEES

Full encirclement reinforcement of horizontal or vertical branch connections.

Working closely with pipe line engineers, Ladish continues to pioneer fittings designed to simplify installation and improve transmission efficiency. Notable examples are illustrated on this page. To get more information on these developments . . . and the complete line of Ladish Controlled Quality pipe fittings, use the coupon below.

HIGH YIELD FITTINGS

In sizes through 42"
36,000-52,000 yield.

ANCHOR FLANGES

When imbedded in concrete restrict line movement.

MULTIPLE OUTLET FITTINGS

Reduce cost and simplify installation of gate settings.

LADISH GENERAL CATALOG No. 55

This 304-page reference manual presents complete data on the Ladish line of Controlled Quality Fittings . . . includes 56 pages of piping engineering data.

BULLETIN 55-1

21-page bulletin presents descriptive data on Ladish pipe line fittings developments.

BULLETIN 55-2

82-page volume tabulates and graphically charts design pressures for steel pipe for gas transmission and distribution systems in accordance with recently revised Section 8 of ASA. B-31.1.8.

TO MARK PROGRESS

LADISH CO. Cudahy, Wisconsin (Milwaukee Suburb)

Please send:

- ☐ LADISH GENERAL CATALOG No. 55
- ☐ BULLETIN 55-1
- ☐ BULLETIN 55-2

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

THE SOLUTION:

In-Place *Coating with Humble Epoxy Internal Pipe Coatings*

Humble's epoxy internal pipe coatings can be applied *in-place* in a single application in new or used pipe. They effectively stop corrosion in pipelines that are exposed to extreme internal corrosive conditions, and greatly extend the life of these lines. Several miles of pipe can be coated internally at one time.

In addition to giving excellent resistance to sour crudes and brine, Humble epoxy internal pipe coatings give a smooth, glossy finish that cuts down paraffin deposition.

For more information on Humble protective coatings, see your nearest Humble wholesale plant in Texas and New Mexico, or write or phone:

Technical Service
Sales Department
Humble Oil & Refining Company
P. O. Box 2180, Houston 1, Texas

HUMBLE

HUMBLE OIL & REFINING COMPANY

economic forecast available. It is transmitted from the top administrative level and is used as a guide for the lower echelons of management during the coming year.

2. The Planning Period—The length of the planning period ranges from 1 to 5 years, but only three companies report that they make capital planning programs for longer than 1 year. Even then, however, the long-range forecasts are revised annually, for at best they represent only rough estimates.

The consensus is that the value of a detailed long-term budget does not merit the time and trouble that must be put into it. Nevertheless, there is growing belief that a sensible budget cannot be based on one-year forecasts alone since many capital projects may require several years to construct before operations begin.

3. Flexibility—Flexibility is incorporated into the plan to compensate for changing conditions. A high degree of flexibility seems to characterize the smaller companies, whereas more rigid controls are inherent in the budgets of larger firms.

Tight control over revisions has at least one advantage in that it tends to make for better planning when executives know that there is little opportunity for them to correct planning errors. Conversely it may pose a limitation on new schemes which are of value to the company.

3. Criteria For Discrimination—Desired expenditures almost always exceed the practical limits of available means. Consequently, methods are devised for selecting desirable projects and for eliminating those which do not contribute their proportionate share toward attaining the over-all objective.

In the selection process individual proposals are scrutinized and compared with other budget candidates on the basis of:

- The length of the payout period.
- The rate of return that is expected from the investment.
- The degree of necessity attached to each.

Pay-out. The reporting companies universally use years-to-pay-out to distinguish between "good" and "bad" investment proposals. This method is based on the number of years expected to elapse before the gross earnings of a new project return the original investment. When the project will pay for itself within two, three, or four years, it assumes a high degree of attractiveness. When pay-out is projected beyond that time, it becomes progressively less attractive as the period increases.

Return on Investment. Two methods are used to calculate return on investment:

1. Compute a ratio of average anticipated earnings, after taxes and depreciation, to some measure of investment, either original outlay or average book value. (Twelve of the 15 firms consider this just another way of stating payout.)

2. Compute the return on the investment actually outstanding from time to time over the life of the venture—the financial method. Three reporting firms use this technique.

TABLE 2

Appraisal of New Capital Investments

Comparison of Methods: Investments with Increasing Income

ASSUMPTIONS:

Original Investment		$ 56,502
Annual Income, After Taxes Before Depreciation	(1st to 3rd yrs.)	6,000
	(4th to 7th yrs.)	10,000
	(8th to 10th yrs.)	14,000
Life of Investment		10 years
Total Income		$ 100,000
Total Profit After Return of Original Investment		43,498

1. Return Based on Original Investment:

Average Annual Income, After Taxes Before Depreciation		10,000
Deduct: Depreciation (56,502 ÷ 10 years)		5,650
Annual Income After Taxes and Depreciation		$ 4,350
Return on Investment $\frac{\$4,350}{\$56,502}$ =		7.7%

2. Return Based on Average Investment:

Average Annual Income, After Taxes Before Depreciation		$ 10,000
Deduct: Depreciation $56,502 ÷ 10 years)		5,650
Annual Income After Taxes and Depreciation		$ 4,350
Return on Investment $\frac{\$4,350}{\$28,251}$ =		15.4%

3. Return Calculated by Financial Method:

YEARS	Income	Discount Factor—10%	Present Value
1st to 3rd	$ 6,000	2.4869	$14,921
4th to 7th	10,000	2.3816	23,816
8th to 10th	14,000	1.2761	17,866
	(Equals Investment)		$56,603

Verification of 10% Return:

Year	Income	Interest @ 10%	Return of Principal	Balance of Principal at Beginning of Year
1st	$ 6,000	$ 5,650	$ 350	56,502
2nd	6,000	5,615	385	56,152
3rd	6,000	5,578	422	55,767
4th	10,000	5,535	4,465	55,345
5th	10,000	5,088	4,912	50,880
6th	10,000	4,597	5,403	45,968
7th	10,000	4,057	5,943	40,565
8th	14,000	3,462	10,538	34,622
9th	14,000	2,408	11,592	24,084
10th	14,000	1,249	12,751	12,492
	$100,000	$43,239	$56,761	— 259*

* Does not come to zero because of rounding of numbers

Necessity. Many projects if judged strictly from their profit potential would never be undertaken. But because of government decree, breakdowns in strategic operational phases, etc., certain investments become mandatory and must be put at the top of the priority list regardless of financial expediency.

4. Replacement—When the spending decision involves replacement (not simply an addition to plant capacity) all of the reporting companies resort to rule-of-thumb methods seasoned with experience. Comparisons of operating costs with a standard rate give replacement signals in some cases. Other firms replace automatically after a designated period of time has elapsed.

5. A Recommended Planning Method—Theoretically, not all of the companies responding to the survey have as effective a procedure for planning capital spending as they might have. One company is in the process of changing its procedures to make planning more accurate.

In theory the minimum requisites of a successful capital planning program are:

► Devise a sound budgeting procedure in which adequate attention is given to soliciting investment proposals from the "grass roots" of the company compatible with a high degree of centralized planning and control.

► Determine a minimum acceptable rate of return on each general grouping of facilities—production, refining, transportation and marketing commensurate with the risk inherent therein. One respondent computes its average, long-run cost of capital at about 7 percent after taxes. But in order to expand and obtain a satisfactory return when risks are high, the company expects a return of 10 percent or better on pipe line facilities, 14 percent or better on refining facilities, and 18 percent or better on development wells and petrochemical investments.

► Select a single, meaningful yardstick which may be used to discriminate between proposals involving

COST ANALYSIS DETAIL

AFE Title_____ AFE No._____

Account No.	Item	Estimated				Actual		
		Quantity	Unit	Unit Cost	Item Cost	Quantity	Unit	Item Cost

TOTAL _____

Prepared by: _____

FIGURE 2—Another important phase of expenditure planning is the construction cost and completion report shown above, used by one of the pipe line companies to keep a permanent record of actual costs for future comparisons.

purchases of new equipment. The financial method of calculating return on investment is recommended. The rate, thus determined, may be compared with the minimum acceptable rate to give a definite clue as to the course of action to be followed (see Table 2).

► Consider the Machinery and Allied Products Institute's Replacement Formula as a technique for replacement planning to be used in conjunction with current cost accounting procedures. This formula eliminates guesswork in replacement decisions. It is succesfully used in many other industries.

► Establish a definite policy and an economical procedure which will provide sufficient post-audit information on completed projects to enable management to compare initial predictions with actual results.

Controlling Capital Expenditures

If controls over capital expenditures are designed and administered so as to bear out sound planning principles, the building of the project as well as its ultimate usefulness is assured insofar as knowledge of the future can accurately be predicted. The control schemes found to exist in the companies included in this survey are designed to evaluate the conformity of planned activity and actual results.

Although all of the reporting companies do not have a highly formalized control system, there are two major factors which are typical: Controls related to starting and completing the project—and controls related to the contribution of the project to company operations.

Controls Related to Starting and Completing the Project

These practices fall into the following six major subdivisions:

1. *Inclusion in the Budget.* Fourteen of the 15 companies use a plant and equipment budget. This practice not only assures that capital needs of the firm will be balanced against its capital resources, but that prospective commitments will be examined with a view to determining their conformity to long-range plans. Each proposal must meet certain standards of quality before it is included in the budget. Thus the control, as well as the plan, starts with the budget.

2. *Authority for Expenditure (AFE).* The mere fact that a capital item is approved by the budget committee and incorporated in the budget does not mean that the way is cleared

Meet the Author

GEORGE E. KISER is chairman of the Department of Economics and Business Administration at Texas Western College, El Paso, Texas. Previously he was head of the School of Business at West Texas State College. Before taking up teaching, Dr. Kiser was with E. I. du Pont de Nemours & Company, Inc., at its Savannah River, S. C., project, and before that he was assistant traffic manager for Crown Petroleum Corporation in Houston. A graduate of Leland Stanford University, he took his master's and doctor's degrees in industrial management at The University of Texas. He was a colonel in the Air Force during World War II.

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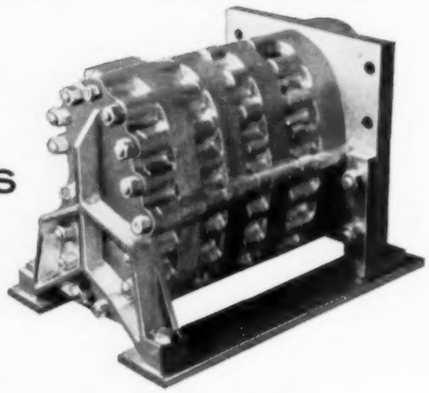

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to commit the funds. All of the surveyed companies use an additional procedure, the AFE, a form which requires the fund-using agency to obtain specific authorization to spend any of its allocations. This form permits top management to take a "second look" at the spending proposal in light of currently prevailing conditions.

The AFE is designed to present pertinent information about the expenditure in question. In addition, supporting details to justify the request for funds are always attached as a part of the AFE. On large projects the AFE file becomes quite voluminous. (See Figure 1, a representative form used by one company.)

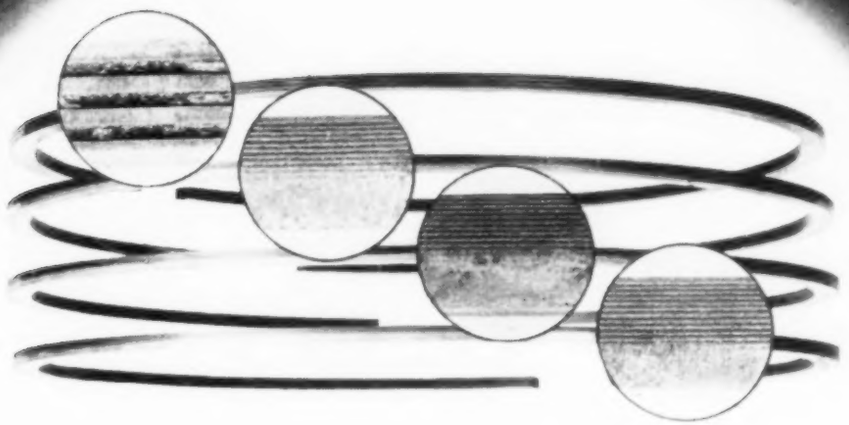
Authority to approve an AFE is delegated to the operating executives. A wide variation exists among the surveyed companies as to the limits of authority assigned to each executive level. This dissimilarity depends not only upon the individuals in those positions but also upon the particular type of asset in question. Delegation is usually more liberal when the item is in the budget than when it is an addition to the budget.

3. *Cost Accumulation.* All of the companies accumulate cost data on authorized capital projects. Typically, all purchase invoices and work orders are routed through the accounting department where they are audited for necessary signatures and proper charges. (Figure 2 is a typical cost accumulation form.)

4. *Supplementary Requests.* The necessity for requesting additional funds arises when costs are not anticipated on the initial AFE, or when such costs are under-estimated. Ten of the reporting firms make automatic allowances for over-runs in the original allocation and do not require a supplementary AFE unless the excess is significant. Significant overruns range from a straight 10 percent of the project cost to a maximum of $10,000, or 10 percent, whichever is least.

5. *Progress Reports.* Periodic progress reports to the president, departmental executives, and other interested officials are used by all respondents. These summaries depict the status of all open appropriations and provide management with a buildup of charges against appropriations.

In addition to the status reports involving accounting facts, major



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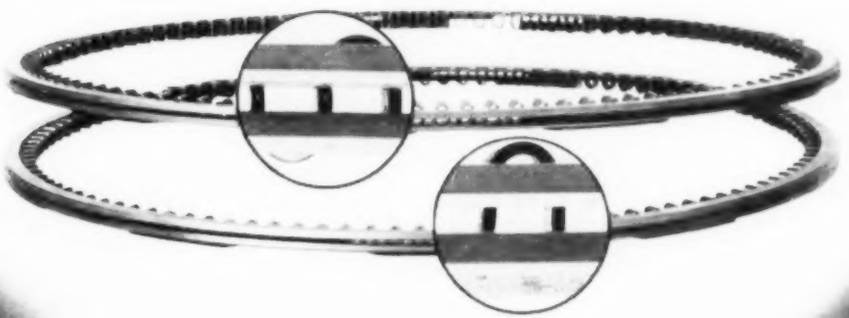

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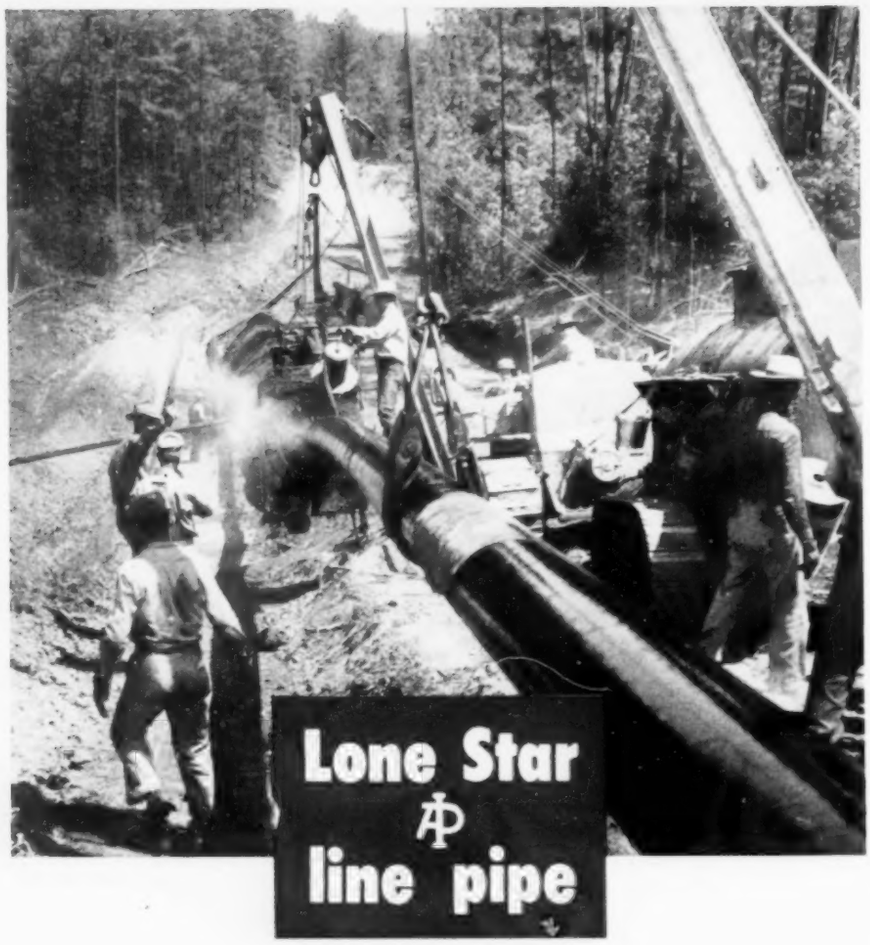

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executives make periodic visits to the construction site while the work is in progress and also at the time the work is completed.

6. *Completion Reports.* Completion reports signal the cessation of construction or installation activity. Invariably the notice will go to the accounting department and often to other major executives.

Controls Related to the Contribution of the Project to Company Operations

This type of control attempts to determine whether the original justification of the proposal is in accord with its actual performance. Only one firm reports that it requires a post audit on *all* completed projects, while one respondent has *no* means of appraising the contribution to over-all company operations.

The remainder of the surveyed companies subject a portion of their finished projects to review. For some projects a complete analysis would be too expensive and time-consuming; the profitability of others is obscured by the intricacy of accounting records.

The Most Accepted Method—The purpose of control of capital equipment spending is to recognize weaknesses and errors in the capital purchasing programs and to form a basis for forecasting the next period.

The control procedures of all surveyed companies that relate to starting and completing the project appear to achieve the purpose of control. But the procedures used to evaluate the contribution of the project to company operations seems inadequate. Too much post-audit control can be expensive while too little control does not throw enough light on the effectiveness of the capital spending program.

Among the surveyed companies, the firm which requires no post audit undoubtedly is not obtaining the maximum benefit from controls, while it may be costing too much for the other firm to audit all completed projects.

Perhaps the correct answer lies in one company's approach—to submit all projects costing over a certain dollar amount to regular review while lesser capital programs are analyzed on a random basis. This establishes a definite policy and an economical procedure which provides sufficient post-audit information for management to compare initial predictions with actual results. **The End**

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Miscellaneous **—28—How to estimate torque to apply to a flange bolt without overstressing it.**

It's easier to tighten a flexible joint too tight than not tight enough. Yet, the tendency of the man behind the wrench is to tighten the bolt to the limit of his strength. The effort needed can be controlled by a torque wrench.

Rule: Multiply the bolt working load in pounds by the diameter in inches by 0.2 to estimate alowable torque for a bolt.

Example: A ½-inch commercial bolt on a station flange can carry a load of 4950 pounds. The customary working load for this bolt is 60 percent of this, or 2970 pounds. Therefore, torque equals 2970 × ½ × 0.2, which is 297 inch-pounds. This torque is equivalent to applying a 37-pound load on an 8-inch wrench.

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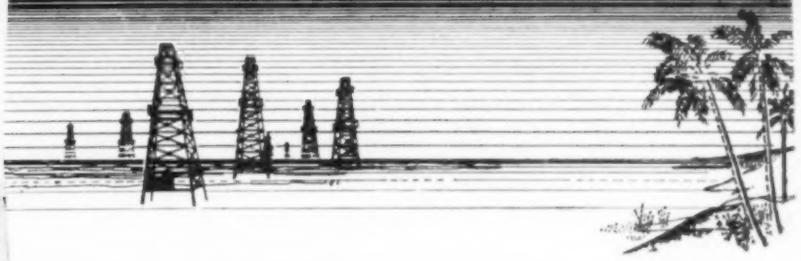

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1200-Mile Line to Transport Middle East Crude Considered

The current Suez Canal crisis has brought into sharper focus several projects for piping Middle East crude to the Eastern Mediterranean. One such project would start in Kuwait, go northwestward through the Basra area of Iraq, up the Tigris Valley through the Mosul area into southeastern Turkey, and then continue westward through southern Turkey to the Mediterranean port of Iskenderun.

This proposed line would cover about 1200 miles and be constructed of 38 or 40-inch pipe. It would bypass both Syria and Lebanon, the two coastal countries through which all present Middle East pipe lines to the Mediterranean now pass. It could cost as high as $500 million to build.

Additional pipe line capacity is essential, regardless of which route or routes are chosen. Kuwait production is at present almost entirely dependent on tankers for a market outlet. 1955 production exceeded a million barrels daily, and is steadily rising. Iran is in essentially the same situation as to outlets and was producing 556,000 barrels of crude daily in May, 1956.

Iraq has an elaborate pipe line system, but it too is strained to the approximate limit of its pipe line and loading facilities. Basrah Petroleum Company is straining its facilities at Fao on the Persian Gulf to capacity, and may either expand them or build a pipe line through northern Kuwait to deep water there.

Together Iraq and Kuwait are now producing over 1.7 million barrels daily. This figure is a good indicator of the minimum pipe line capacity that would be needed immediately in the event of a shut-down of the Suez Canal. And, in five years, the Middle East will certainly need that expanded capacity, regardless.

Welders on Trans-Canada Line

As many as 38 line welders are at work at one time completing the union of 40-foot lengths of pipe on one spread of the Trans-Canada Pipe Lines Ltd. 34-inch natural gas line. Construction has been underway several weeks on the 575-mile section of the line from Burstall, across the Saskatchewan prairie to Winnipeg, Man. When the 2250-mile line is completed, Trans-Canada will take Alberta natural gas to eastern Canada.

Mountain Fuel to Build Facilities in Wyoming

Mountain Fuel Supply Company has received approval from the Federal Power Commission to build pipe line facilities estimated to cost $3 million enabling the company to take 58.8 million cubic feet of natural gas daily from Pacific Northwest Pipeline Corporation for delivery to distribution areas in southwestern Wyoming and Utah.

Mountain Fuel's facilities will include 38 miles of pipe line and 2640 horsepower in compressor capacity at an existing station. Mountain Fuel will construct an interconnection with Pacific Northwest's system in Sweetwater County, Wyo., to take delivery of the gas. Mountain Fuel's capacity will be increased to 285 million cubic feet per day.

The FPC also granted temporary authority to Pacific Northwest to build metering facilities estimated to cost $20,600 for the sale of gas to Mountain Fuel and temporarily authorized the firm to make peak-day deliveries of 117.5 million cubic feet of gas to Colorado Interstate Gas Company.

Washington Gas Light To Build 28-Mile Line

Washington Gas Light Company has been granted Federal Power Commission authority to construct and operate 28.8 miles of pipe line in Virginia at an estimated cost of $3.4 million.

The proposed facilities include 26 miles of 24-inch line from the metering station of Atlantic Seaboard Corporation near Dranesville, Va., to a point near Washington where 2.7 miles of 20-inch line will connect it with a line leading to District of Columbia facilities.

The new facilities will provide additional gas supply for the Virginia area and support the District of Columbia and Maryland areas during high demand periods.

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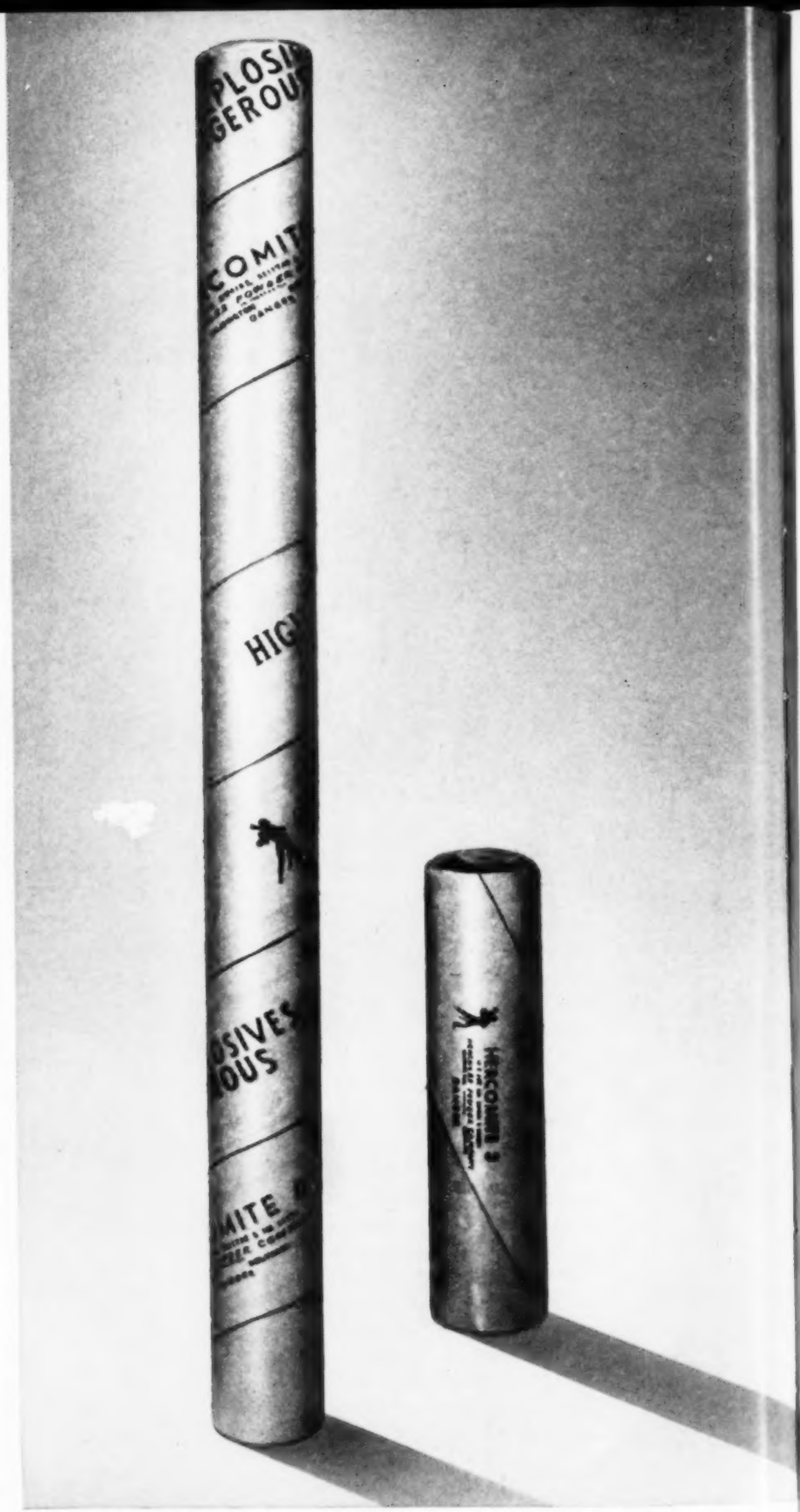

THREE TIMES AS LONG ... Here is one of the new "King-Size" Hercules cartridges 24 inches in length, shown alongside the same grade in the conventional 8 inch size.

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Texas Gas to Transport Gas for American Louisiana

Texas Gas Transmission Corporation has applied to the Federal Power Commission for authorization to build pipe line facilities in Louisiana to transport natural gas for American Louisiana Pipe Line Company.

Estimated to cost $783,100, the facilities will enable Texas Gas to transport a total of 32.6 million cubic feet of natural gas per day from four gas fields for delivery to American Louisiana in Louisiana.

Texas Gas proposes to establish two delivery points into the American Louisiana system. A connection will be constructed near Lowry, La., and used temporarily pending completion of the other construction. The second connection will interconnect major lines on each system near Eunice or North Tepetate, La., and will be the primary delivery point. Texas Gas will build about 12 miles of line near Eunice, install one 540 horsepower compressor unit at an existing station and construct seven measuring stations.

Northern Natural Plans Gathering System in Kansas

Northern Natural Gas Company has announced plans for a gathering system to take natural gas from wells in Clark and Comanche Counties, Kansas, to be brought into Northern's main line system serving the Northern Plains.

Northern has contracted with Shamrock Oil and Gas Corporation to buy gas from four existing wells in the Morrison area of Clark and Comanche Counties. The proposed gathering system will take the gas from this area.

Scranton-Spring Brook Seeks TGT Gas Supply

Scranton-Spring Brook Water Service Company of Wilkes-Barre, Penn., has filed an application with the Federal Power Commission seeking an order directing Tennessee Gas Transmission Company to supply it with natural gas service for distribution in Scranton and Wilkes-Barre, Penn.

Scranton-Spring Brook proposes to interconnect with the Hebron-Green-

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wich facilities of Tennessee and to install and operate approximately 13.45 miles of 12-inch pipe line to connect to its Scranton division and 24 miles of 12-inch line interconnecting the Scranton and Wilkes-Barre divisions. Seven regulating and two metering stations will also be installed.

Natural gas service to Wyoming, Lackawanna and Luzerne counties in Pennsylvania is proposed in lieu of the present artificial gas service. Cost estimate is $1.6 million.

Contract Let for 241-Mile Gas Line From Newhall, Calif., to Topock, Ariz.

A contract for construction of a 241 mile 30-inch natural gas pipe line from Newhall, Calif., to the Colorado River near Needles, Calif., and Topock, Ariz., has been awarded to R. H. Fulton & Co. of Lubbock, Texas. The line is estimated to cost $24 million.

This contract covers the major portion of Southern California Gas Company and Southern Counties Gas Company's $33.5 million pipe line project to bring an additional 278.2 million cubic feet of gas a day into southern California.

A 49-mile line from Newhall to Alhambra, Calif., which will connect with the main line, is under construction and expected to be completed by December.

Fulton crews are expected to begin right-of-way work, grading and trenching in October with construction getting underway in January. Officials announce that they expect the line to be completed about June 30, 1957.

In addition to the Colorado, two other rivers will be crossed. Both are suspension bridges, one a 650-foot span over the Santa Clara River near Newhall and a 400-foot span over the Mojave River north of Victorville.

The line will cross desert and mountainous country, and excavation of hard rock is expected to be one of the major construction problems.

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Permian Basin Pipeline to Add Compressor Units in Texas

Permian Basin Pipeline Company has received authorization to build and operate $1 million in compressor facilities at its Andrews Gasoline plant in Andrews County, Texas.

The new facilities, which include five additional 1350 horsepower compressor units, will enable Permian to receive 50 million cubic feet of natural gas per day from Phillips Petroleum Company in Andrews County.

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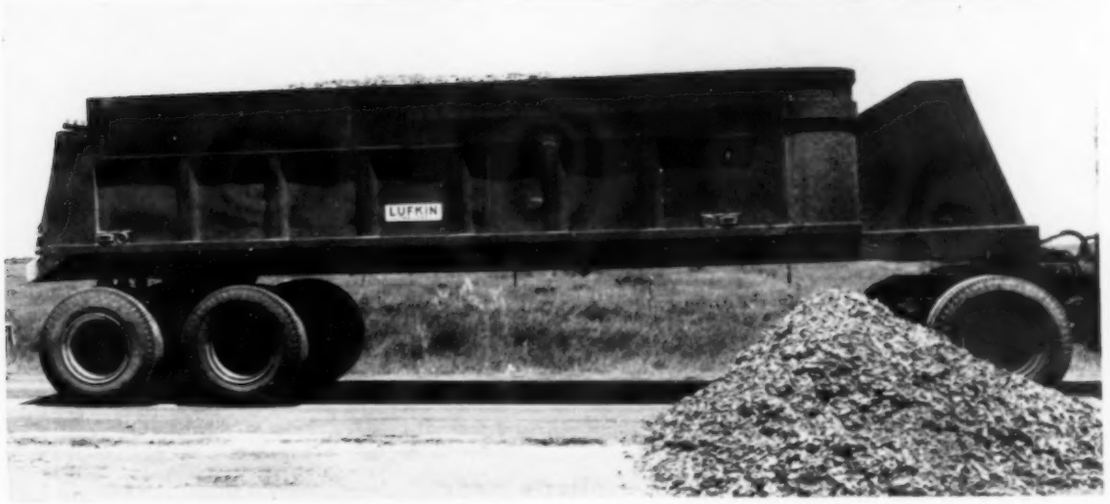

LUFKIN'S Advanced HYDRAULIC Headlift Trailer Design offers these *EXTRAS*

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3. SAFETY—(Cannot fall—nothing to break or wear)
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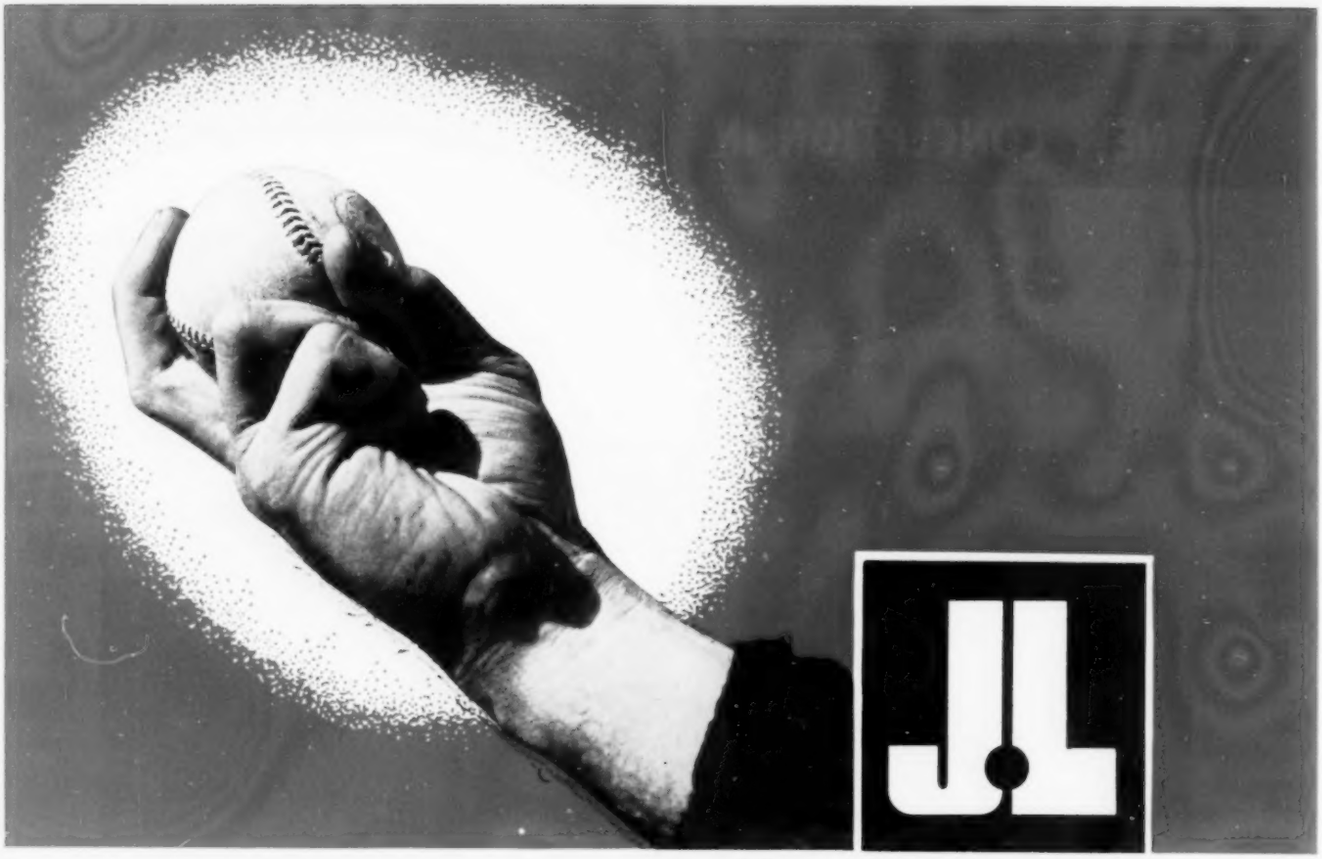

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Several Corrosion Meetings Scheduled by NACE for Fall

Several corrosion control short courses and meetings on corrosion are planned by the National Association of Corrosion Engineers for this fall.

A five-day short course given by the Department of Metallurgical Engineering at Ohio State University in cooperation with the NACE will be held September 10-14 on the campus in Columbus. Inhibitors, protective coatings, and cathodic protection will be among the topics covered.

September 20-21 are the dates for the Shreveport Section, NACE sixth annual short course to be held on the campus of Centenary College. This course is designed to interest superintendents, field men and corrosion engineers. Field trips include a demonstration of a rectifier installation for cathodic protection of a pipe line.

Cathodic protection and corrosion in the transportation industry will be covered in one of the symposia at the annual meeting of the South Central region of the NACE in San Antonio October 23-26 when corrosion specialists from a seven-state area will meet to discuss problems and hear technical papers.

Aramco Line Underway From Safaniya to Ras Tanura

Work is underway on The Arabian American Oil Company's 137-mile 22-inch crude oil line linking the Safaniya oil field with the Ras Tanura refinery and terminal. Scheduled for completion in April, 1957, the project is estimated to cost $12 million. International Bechtel Brothers Inc., is contractor.

Initial capacity of the line will be 50,000 barrels daily but facilities will be constructed to handle an increase to 125,000 barrels daily.

The coastal route of the line, 55 miles shorter than a proposed inland route, was chosen in spite of problems of the salt flat peculiar to that terrain. After rainstorms, these topographic troughs are known to have remained filled with water, hampering construction. In the event of such problems, portions of the line may be built across the area on pilings rather than buried like the remainder of the line.

The line will have 16-inch main gathering line and 8-inch flow lines.

Work Underway on Line For Pacific Gas & Electric

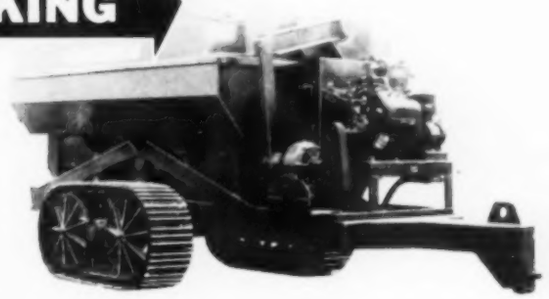
Work is underway on an $800,000 natural gas pipe line through which Pacific Gas and Electric Company will supply fuel to the new Cushenberry plant in California which Permanente Cement Company is constructing at Lucerne Valley, 34 miles to the south.

The line, to be constructed by the joint venture firm of Engineers Limited Pipeline Construction Company and Alex Robertson, will tap Pacific Gas and Electric's "Super Inch" main line east of Daggett, Calif., and will have a transmission capacity of one million cubic feet an hour. The first 23 miles will be of 10-inch diameter pipe and the remaining 11 miles of 8-inch. Construction is scheduled for completion late this year.

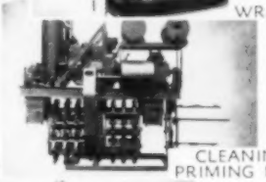
Transco Seeks 50% Boost For Tidewater Facilities

The Federal Power Commission has accepted for filing an application by Transcontinental Gas Pipe Line Corporation seeking authority to construct $8.5 million facilities to boost by 50 percent the amount of gas pre-

NO COKING



COATING AND WRAPPING MACHINES



CLEANING AND PRIMING MACHINES

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Agitator mat bars scrape entire kettle bottom every 3.35 seconds, allowing no material to remain on bottom long enough to burn, eliminating coking completely. Mat motion is slow enough so dope is not "whipped." Heavy mat will not float, scrapes bottom thoroughly.

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viously requested for the tidewater areas of North and South Carolina.

The proposed added construction consists of 30.90 miles of 36-inch pipe line and 42.94 miles of 30-inch line to be constructed in Louisiana, Mississippi, Alabama, Georgia, South Carolina, North Carolina, Virginia and Pennsylvania. These facilities would be constructed during 1957 and would raise the cost of the entire project to $50.8 million.

An additional 20 million cubic feet per day above the 40 million capacity originally proposed would be available with the increased facilities.

Trans Mountain to Build Two New Pumping Stations

Trans Mountain Oil Pipe Line Company is erecting two more pump stations on its line from the Alberta oil fields to Vancouver, B. C. The new stations at Jasper and Gainford, Alberta, will bring the line's capacity to 200,000 barrels daily.

Engineering for the plants was completed by Canadian Bechtel Ltd., with the design work subcontracted to the engineering firm of B. D. Bohna & Co., Ltd., of Vancouver.

Colorado Interstate Plans $3 Million Project in Kansas

The Federal Power Commission has granted temporary authority to Colorado Interstate Gas Company to construct and operate natural gas facilities estimated to cost $3 million.

These facilities are part of the $76.6 million facilities which Colorado Interstate proposes to increase deliveries to Natural Gas Pipeline Company of America by 350 million cubic feet per day.

The temporary authorization covers a 24 mile 16-inch loop between the Morton County, Kansas, station and the Fourway-Kit Carson main line; 8000 compressor horsepower, dehydration plant additions and check meter station addition at the Morton County station.

Cities Service Proposes $2.8 Million Gas Facilities

Natural gas facilities including 35 miles of pipe line in Kansas, Missouri and Oklahoma are proposed by Cities Service Gas Company. Temporary authorization for the $2.8 million project has been granted by the Federal Power Commission.

The project includes drilling and connecting 55 injection and withdrawal wells in the McLouth Storage field, Kansas; installing 6750 compressor horsepower in stations in Kansas, Missouri and Oklahoma, and building 35 miles of 6, 12, and 16-inch pipe line in Buchanan County, Mo.; Platte and Leavenworth Counties, Kansas; Johnson and Lafayette Counties, Mo., and Lincoln County, Kansas.

FPC Authorizes Facilities In Oakford Storage Field

New York State Natural Gas Corporation and Texas Eastern Transmission Corporation have been authorized to construct $2 million in facilities in their jointly-owned Oakford storage field in Westmoreland County, Penn.

Facilities planned in 1956 are the installation of 6000 horsepower of additional compressor capacity at the existing Jeanette station; transfer from Jeanette station of a 350 horsepower unit to the South Oakford station; and construction of one mile of 20-inch, 3 miles of 6⅝-inch line and 23 measuring stations at the Oakford storage project.

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HOT WEATHER OR COLD, Lion E-120 coating goes on smoothly, makes a firm bond with the metal, and forms the impervious insulating layer required by corrosion engineers. Made by one of the most experienced producers of asphalt coatings, Lion E-120 is the result of six years' intensive development and testing. Both in the laboratory and under the most adverse field conditions during the past fourteen years it has proven its complete reliability.

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Engineered to meet specifications of the pipeline industry.
Consistent high quality maintained by constant testing.
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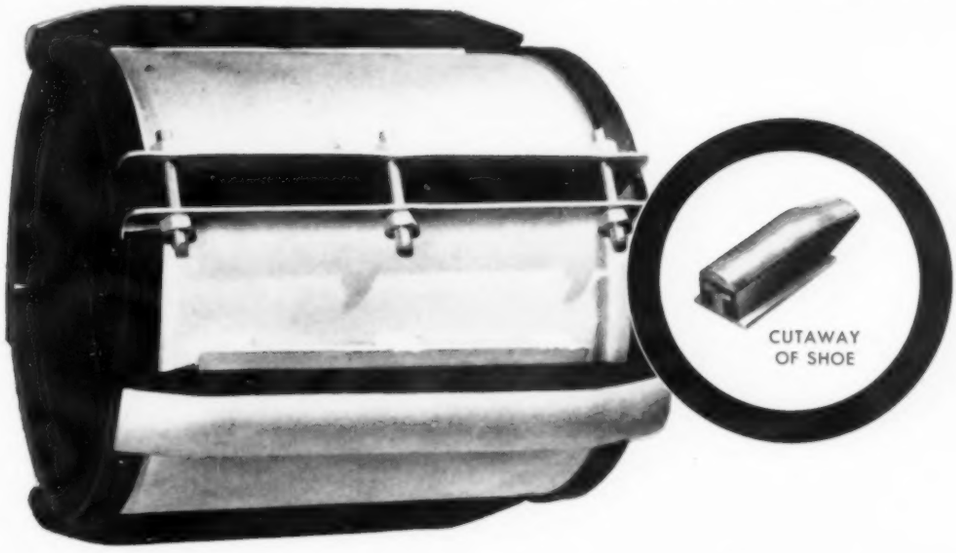
Model 55 Maloney Insulators for LARGE JOBS



Model 56 Maloney Insulators for Small Jobs

Maloney Insulators for *Every Job!*

Maloney Crossing Insulators for pipeline casing are exceptionally rugged, easy-to-install . . . *and adaptable to a wide range of pipe sizes and differentials.*

Because they are bonded metal-to-neoprene-to-metal, Maloney Insulators provide good shock-absorption, plus flexibility to compensate for pipe shifting.

Streamlined "sled-type" steel runners make for easy entry into the casing, and prevent hanging-up on casing welds as pipe is being run.

Model 55 Maloney Crossing Insulators, in all sizes through 36", are fitted with an extra-wide steel band for positive grip. Model 56, for pipe size differentials from 2" to 12", are fastened to the carrier pipe with stainless steel bands. Both types offer greater dependability—greater protection against corrosion with high dielectric strength neoprene, and against physical damage with steel runners—than any other insulator on the market. Maloney Crossing Insulators are in use on most of the country's major pipelines.

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Forward Thinking Crose Engineering has produced *another* machine to reduce pipeline construction costs! This ditch padder has a screening head and conveyor that completely pads coated pipe with selected soft, rock-free soil. Sharp, pipe-damaging rocks are eliminated. No longer must padding material be hauled in from distant locations—now you can use all the good material from the spoil bank.

The Crose self-powered unit is quickly attached or detached from a standard pipeline side-boom tractor in a matter of minutes . . . releases tractor for other work along the line when not padding pipe.

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Proposed Pipe Line Construction

COMPANY	Length in Miles	Diameter	Type	Origin and Terminus	Estimated Cost	Status
Alberta Gas Trunk Line, Ltd.	547	6-34	Gas	From Alberta fields to western terminus of Trans Canada Pipe Line, Ltd.	$47 million	Approved
American Gilsonite Company	71	6	Gilsonite Slurry	From Bonanza, Utah, to Gilsonite, Colo.	$2 million	Approved
Andes Pipeline Corp.	500	12	Gas	From Villamontes, Bolivia, across Andes to Antofagasta, Chile	$30 million	Planned
Bolivian Gulf Oil Co.	201	8-10	Crude	Sicasica, Bolivia to Arica, Chile	.....	Planned
Chaco Pipeline & Refinery Corp.	450	....	Products	From Glenn McCarthy's Bolivian wells to new refinery at Conception, Paraguay	.....	Planned
Cities Service Gas Co.	35	6, 12, 16	Gas	Facilities in Kansas, Missouri, and Oklahoma	$2.8 million	Authorized
	28	20-30	Gas	Facilities in Oklahoma	$1.4 million	Temporary authorization
Coastal Transmission Corp.—Houston, Texas	565	20-26	Gas	McAllen, Texas—Louisiana connection, Houston, Texas Gas, plus 272 miles of laterals	$68 million	Before FPC
Colorado Interstate Gas Co.	800	16-30	Gas	Laramie, Wyo. to Beatrice, Neb. to deliver gas from Rocky Mountain area and Texas and Oklahoma Panhandle fields to Natural Gas Pipe Line Co. of America	$76 million	Before FPC
Compania Shell de Venezuela	177	20	Gas	La Paz field to Cardon refinery on Paraguana peninsula	$20 million	Planned
Consolidated Gathering Systems, Ltd.	198	....	Crude	Sturgeon Field—Edmonton.	.....	Planned
Creole Petroleum Corp.	94	28	Crude	Temblador to Caripito, Venezuela	$5.6 million	Planned
Deep Rock Gas Co.	120	6	LPG	Tioga, N.D.—Canadian border	.....	Planned
El Paso Natural Gas Co.	888	....	Gas	Facilities in Texas, New Mexico, and Arizona to deliver gas near Blythe, Calif. and Topock, Ariz. to So. Counties Gas Co., So. Calif. Gas Co. and Pacific Gas & Electric Co.	$84.5 million	Before FPC
	108	....	Gas & Products	Facilities in Andrews and Ector Counties, Texas	$5 million	Authorized
El Paso Natural Gas Products Co.	240	8	Products	Midkiff natural gasoline plant in Permian Basin to El Paso	.....	Planned
Houston Texas Gas & Oil Co.—4604 Main St., Houston	961	12-30	Gas	Baton Rouge, La. to Miami, Fla. plus 496 miles of laterals and compressor facilities	$105 million	Before FPC
Inland Natural Gas Co.	320	6-12	Gas	To tap Westcoast Transmission's trunk line at Savona, British Colombia.	.....	Planned
Interprovincial Pipe Line Co.	150	20	Crude	Sarnia, Ont. to Toronto, Ont.	.....	Planned
Interstate Oil Pipe Line Co.	55	8	Crude	Billings, Mont. to Wolf Springs, Mont.	.....	Considered
Iraq Petroleum Co.	50	24	Crude	Homs, Syria, to Mediterranean	.....	Considered
	1,200	38-40	Crude	Kuwait to Iskenderun, Turkey	.....	Considered
Iron Ranges Natural Gas Co.	115	....	Gas	From Itasca and St. Louis Counties along route of Mesabi range from Grand Rapids to Aurora, Minn.	$5 million	Before FPC
Iroquois Gas Corp.—Buffalo, N.Y.	36	....	Gas	Facilities in Chautauqua, Cattaraugus and Erie counties, N.Y. to develop new underground storage area for natural gas	$2.8 million	Authorized
Kansas-Nebraska Natural Gas Co.	32	....	Gas	Facilities in Nebraska	$4 million	Authorized
Magna Pipeline Company	40	....	Gas	Underwater line from Anacortes, Wash. to Victoria, B.C.	$6 million	Planned
Magnolia Pipe Line Co.	....	8, 12	LPG	Facilities in Andrews County, Texas	.....	Planned
Mene Grande Oil Co.	62	30	Crude	Anaco to Puerto La Cruz, Venezuela	$5.8 million	Considered
Michigan-Wisconsin Pipe Line Co.—500 Griswold, Detroit	472	4-24	Gas	Main line loops and extensions in Wisconsin, Illinois	$17.6 million	Before FPC
	252	....	Gas	Loops in Missouri, Iowa, Wisconsin and Illinois.	.....	Contracts let for 188 miles
Midwestern Gas Transmission Co., Houston, Texas	1112	....	Gas	Emerson, Manitoba—Nashville, Tenn.	$98 million	Before FPC
Montana-Dakota Utilities Co.—Minneapolis	44	....	Gas	Various locations in S.D. and Wyoming	$1.4 million	Authorized
	41.8	12	Gas	Williams County, N.D.	$1.4 million	Authorized
	28	12	Gas	Fallon County to Dawson County, Mont. and compressor facilities	$776,280	Authorized
Mountain Fuel Supply Company	38	20	Gas	Parallel line and facilities to transport gas from Pacific Northwest line in Sweetwater County, Wyo.	$3 million	Authorized
NATO	1920	4-10	Products	To serve military bases in Western Europe	.....	Foster-Wheeler Prime Contractors, 1330 miles let
Natural Gas Pipe Line Co. of America—20 N. Wacker Dr., Chicago	350	20, 26	Gas	Wise County, Texas—Fritch, Texas	$28.5 million	Authorized
	25	....	Gas	Quinduno field in Roberts County, Texas	$3.2 million	Authorized
	480	30, 36	Gas	Loops at various points along existing line	$80 million	Before FPC
New York State Natural Gas Corp.	27	....	Gas	Elk County, Penn. to Luthersburg gas field in Clearfield, Jefferson and Indiana Counties, Penn.	$1.5 million	Authorized
North Carolina Natural Gas Corp.	575	3-16	Gas	Mooresville eastwardly across North Carolina	$13 million	Authorized
Northern Natural Gas Co.—2223 Dodge St., Omaha	167	24	Gas	Farmington, Minn. to Duluth, Minn. and Superior, Wis.	$12 million	Before FPC
	....	....	Gas	To interconnect with Natural Gas Pipe Line	$244,000	Planned
	28.4	30	Gas	Test lines to underground storage near Redfield, Iowa	$4.8 million	Authorized
	15	....	Gas	Loop line in Nebraska and install additional compressor horsepower in system in Texas, Kansas, Nebraska, Iowa	$4.7 million	Authorized
Northwest Pipeline Corp.	350	....	Crude & Products	Four Corners area to Salt Lake City, Utah	$15 million	Planned
Offshore Gathering Corp., Houston	364	24, 26, 30	Gas, Crude	Texas side of Sabine River 25 miles offshore La. to Mississippi side of Pearl River	$150 million	Planned
Pacific Gas & Electric Co.	150	34	Gas	Various loops, between Topock, Ariz.—Milpitas, Calif.	$20 million	85 miles let
	83	12, 18, 20	Gas	Glenn County areas to Sacramento region	$5 million	Planned
Pacific Northwest Pipe Line Corp.—Salt Lake City, Utah	1,487	22, 26	Gas	San Juan Basin—Pacific Northwestern states and Canadian border terminus near Sumas, Wash. plus 732 miles of supply and sales laterals	$246 million	Contracts let for main line and 477 miles of laterals
	50	46	Gas	To serve industrial customers at Uravan and Nucla, Colo.	$1 million	Authorized
Pembina Pipe Line, Ltd.	100	....	Crude	Gathering line and new pumping unit in West-Central Alberta	$4.5 million	Planned
Pennsylvania Gas Co.	38	8, 10	Gas	In Erie and Warren Counties, Penn., and Chautauqua County, N.Y.	$930,000	Before FPC
Petroargentina	370	16	Crude	Newguen—Bahia Blanca, Argentina	$40 million	Planned
Petroleos Mexicanos—Ave. Juarez, 94, Mexico City	440	20	Gas	Brazil—Tampico—Poza Rica, Mexico	.....	Planned
	145	12	Crude	18 de Marzo Field—Monterrey, Mexico	.....	Considered
	80	8	Products	Guaymas—Los Mochis	$1 million	Planned
Phillips Petroleum Co.—Bartlesville	54	6	Products	Goldsmith—Borger, Texas	.....	Planned
Piedmont Gas Co.—Hickory, N.C.	22	20	Gas	Roberts County, Texas, to Rock Creek gasoline plant	.....	Approved
	78	2-8	Gas	From connection with Transcontinental Gas Pipe Line to serve customers in North Carolina	$2.6 million	Before FPC
Royal Dutch Shell	700	30	Crude	Mediterranean Sea to North Sea ports	$280 million	Considered
Saskatchewan Power Corp.	80	....	Gas	Hatton gas field to Success, Sask.	.....	Planned
	40	....	Gas	Moose Jaw, Sask. to Regina, Sask.	.....	Planned
Scranton-Spring Brook Water Service Co.	37	12	Gas	Hebron-Greenwich facilities of Tennessee to Scranton and Wilkes-Barre, Pa.	$1.6 million	Before FPC
Sinclair Oil & Refining Co. and Socony Mobil Oil Co.	211	....	Crude	San Silvestre field, Barinas, Venezuela, to Puerto Cabello on Caribbean sea coast	$25 million	Planned
Sohio Petroleum Co.	37	8	Products	Mogadore to Girard, Ohio	.....	Planned
South Alberta Pipe Line, Ltd.	46	10	Gas	Etzikom Field—Medicine Hat, Alberta	$1 million	Planned
South Saskatchewan Pipe Line Company	58	12	Crude	Cantuar field to Dollard field, Saskatchewan	$3 million	Approved
Southern Calif. Gas Co. & Southern Counties Gas Co.	241	30	Gas	Newhall, Calif. to Topock, Ariz.	$31 million	Contract let
Southern Natural Gas Company	52	....	Gas	Various locations in Ga. and La.	$2.2 million	Authorized
Southern Pacific Pipe Lines, Inc.	300	....	Products	From San Francisco Bay area to Reno—Fallon, Nev. area	$16 million	Planned
Stanmount Pipe Line Co.	140	10	Crude	Cayiga and Beaver Lake Fields, N.D. to connect with Interprovincial Pipe Line	.....	Planned

APV Company Lays in a Steep One Through Rugged Washington Terrain

Down Goes a Trencher

Here the 125-drawbar hp, 37,677-lb (as illustrated) HD-16 holds a trencher working down a steep hillside. Allis-Chalmers engine with follow-through combustion delivers plenty of power to take steep hillside work in stride.

Fort Worth, Texas, Contractor Uses All Allis-Chalmers—Tractomotive Spread on 83-mile Plymouth to Goldendale, Washington, Job.

Forty-five percent grades, extremely rocky terrain and high winds that at times stopped operations completely made going tough, but APV's spread of Allis-Chalmers dozer tractors and Tractomotive-equipped side boom crawlers took it right in stride and kept this 26-inch natural gas line right on schedule.

Contractor Rates Allis-Chalmers Equipment "Excellent"

All tractors on the job are the newest Allis-Chalmers models, engineered with latest advanced-design features. Contractor A. P. Vaughn stated, "I rate Allis-Chalmers tractors excellent on every count. They've got the balance for steep hillside work; plenty of power; smooth, dependable torque converter drive for cradling, and there's nothing can touch them for easy maintenance. We didn't have a bit of tractor downtime on the entire job."

The spread consisted of three HD-21 crawlers, three HD-16's, and two HD-11's all with Tractomotive side booms; seven HD-16's with angledozers; one HD-11 tow tractor, another with backfiller. An Allis-Chalmers Model Forty Five motor grader handled final right-of-way leveling.

Preparing the R-O-W

Two HD-16's equipped with angledozers and winches are grading right-of-way ahead of ditching crews. Exclusive all-steel Box-A Main Frame makes possible better equipment mounting . . . superior over-all balance.

A Lift for the Stringers

An HD-16 helps a loaded truck up a 40° slope. *Ray Herron*, Supt. for Parkhill Trucking Co., Tulsa, Okla., says: "We think they're the best. We've bought a lot of them this year." Operator Ernest Kay adds, "You can't beat them as tow tractors. Torque converter makes winching easy to control."

Fast Line-up on the Rolling Hills

Easy does it with a 75-drawbar hp, 34,134-lb HD-11 with Tractomotive side boom on the job. Maximum lifting capacity is 40,200 lb at 4-ft overhang. Front-mounted power take-off from engine crankshaft permits side boom to work independently of tractor master clutch.

An Assist for the Bender

Here the versatile HD-11 holds a pipe section for the bending crew. Operator Jerry Stephens says, "Man, these are honest crawler tractors; you can't beat them. I don't think there's a tractor made that'll keep up with Allis-Chalmers side boom crawlers."

Smooth for Cradling

Here two HD-21's, 204 net engine hp, 78,250 lb each, cradle pipe for dope-wrap crew. Maximum lifting capacity is 127,000 lb at 4-ft overhang. Operator Elmer Pettus says, "No other tractor will keep up to Allis-Chalmers on this kind of work. I've run all of them and this is the best."

In Goes the Pipe

Two HD-16 torque converter tractors lower pipe. HD-16 has 150 net engine hp, weighs 57,840 lb, handles 77,580-lb maximum load. Tractomotive side boom features drop-proof counterweights; fully-enclosed internal expanding brakes; pin-connected frames for simplified servicing; easy-working, convenient controls.

HD-11 Speeds Backfilling

HD-11, equipped with backfiller, rolls right along on backfilling. Eighty-four-in. center-to-center tread width, up to 24-in. track shoes and long track with seven heavy-duty truck wheels give this crawler the balance and stability for long reaches.

Cleaning up Right-of-Way

HD-16 with angledozer cleans up right-of-way. Tractor puts in more hours on the job with features like simplified adjustments, fewer lubrication points and 1,000-hour lubrication periods for truck wheels, support rollers and idlers.

The Finishing Touch

Here an Allis-Chalmers Model Forty Five motor grader puts final grade on right-of-way. ROLL-AWAY moldboard reduces friction drag by rolling load up and ahead of the blade edge . . . makes more efficient use of engine power. Toggle-type controls give the operator finger-tip command of every blade position, every job.

ROLL-AWAY is an Allis-Chalmers trademark.

Check the picture highlights of the job. Then check with your Allis-Chalmers — Tractomotive dealer for all the big advantages that make Allis-Chalmers crawlers and Tractomotive side booms top performers on any spread.

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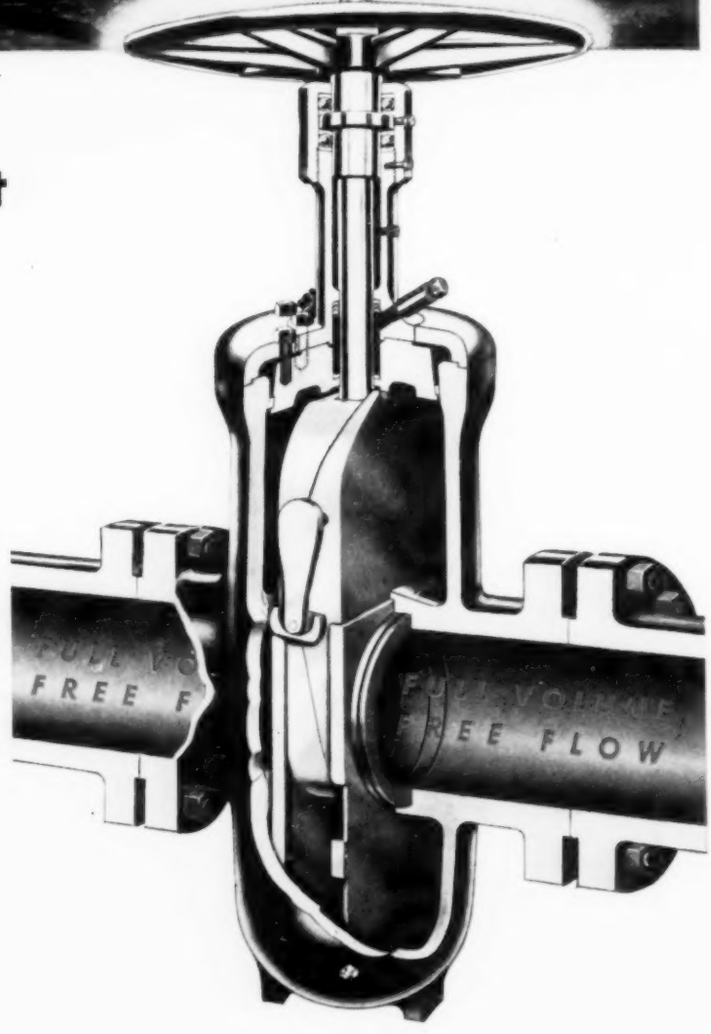
Through-Conduit VALVES

Main lines with W-K-M Valves all the way are the "expressways" of pipeline transportation. The smooth bore through a W-K-M Valve is the same as the I.D. of the pipe and permits the same full volume, free flow as the pipe itself, and allows no more pressure drop or turbulence than an equivalent length of smooth wall pipe. Pump or compressor power is concentrated on transmission — not wasted overcoming obstructions. Scrapers may be run freely through the valves when cleaning the line.

Other advantages of W-K-M Pipeline Valves that contribute to their efficiency in service on the line are Leverlock Control of the parallel expanding gate; pressure seal bonnet that seals tighter as pressure increases; renewable seats; Superfinished stems, ball bearing operation for easier opening and closing under any conditions.

Write or ask your W-K-M Representative for our new pipeline catalog No. 300.



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W-K-M THROUGH-CONDUIT GATE VALVES

acf LUBRICATED PLUG VALVES

KEY RETURN BENDS AND FITTINGS

Proposed Pipe Line Construction—(Continued)

COMPANY	Length in Miles	Diameter	Type	Origin and Terminus	Estimated Cost	Status
Sturgeon Pipe Line Ltd.	100	12	.....	Sturgeon Lake Field—Trans-Mountain system	$6,500,000	Planned
Sui Gas Transmission Company	200	16	Gas	Sui field in Pakistan to Multan in southern Punjab	.....	Contract let
Sunflower Pipe Line Co.—Tulsa, Okla.	265	3-6	LPG	Kearny, Grant and Haskel Counties, Kansas—Wichita, Kansas	$3.5 million	Authorized
Tecumseh Pipeline Co.	....	20	Crude	To connect to principal crude line carriers in Chicago area for movement to east	.....	Planned
Tennessee Gas Transmission Co.—Box 2511, Houston (See also Midwestern Gas Transmission Co.)	100	....	Gas	Gathering lines in Texas and Louisiana plus station additions	$18.6 million	Before FPC
	162	26, 30	Gas	Loop Lines in Kentucky, Ohio, and Pennsylvania	$24.3 million	Authorized
Texas Eastern Transmission Corp.	422	30	Gas	McAllen to Vidor, Texas	Estimated	Before FPC
	530	30	Gas	Loops at various points between Kosciusko, Miss. and Uniontown, Penn.	Cost of Entire Project	Before FPC
	45	24	Gas	Provident City, Texas crossover to McAllen-Vidor line	$150	Before FPC
	135			Supply and delivery lines laterals	Million	Before FPC
Texas Illinois Natural Gas Pipeline Co.	59	36	Gas	Loops facilities in Illinois	$6.4 million	Before FPC
Texas Gas Transmission Corp.	40	6-30	Gas	Parallel lines and compressor additions on existing lines in Louisiana, Missouri, Mississippi, Illinois, Kentucky	$6 million	Authorized
			Gas	To deliver gas from four Louisiana gas fields to American Louisiana system.	$783,100	Before FPC
Trans-Canada Pipe Line, Ltd.—Calgary, Alberta	2250	30, 36	Gas	Alberta—Eastern Canada	$378 million	Contracts let for 4 spreads
Trans Carolina Pipeline Co.	280	8-18	Gas	Transmission line and compressor facilities plus 567 miles of laterals in tidewater areas of North and South Carolina	$21.6 million	Before FPC
Transcontinental Gas Pipe Line Corp.—3100 Travis St., Houston	....	....	Gas	Connecting facilities with Texas Eastern Penn-Jersey in Pennsylvania and New Jersey	$131,628	Authorized
	24.2	....	Gas	Gathering Lines from South Bayou Mallet, Maxie and Happytown Fields, La.	$754,000	Authorized
	12	....	Gas	Live Oak gas field, Vermillion Parish, La. plus two meter stations	$707,000	Before FPC
	277	30, 36	Gas	In Louisiana, Mississippi, Alabama, Georgia, S. Carolina, N. Carolina, Virginia, Maryland, Pennsylvania	$42 million	Authorized
	74	30, 36	Gas	In Louisiana, Mississippi, Alabama, Georgia, South Carolina, North Carolina, Virginia and Pennsylvania	$8.5 million	Before FPC
Union Oil Co. of Calif.—Los Angeles, Calif.	225	12, 16	Crude & Products	San Joaquin Valley to Union Oil's Oleum refinery on San Francisco Bay.	.....	Planned
United Natural Gas Co.	50	12	Gas	Elk County—Jefferson County, Pa.	.....	Planned
U. S. Navy	450	8	Gas	Gubik Field—Fairbanks, Alaska	$20 million	Planned
Washington Gas Light Co.—Washington, D.C.	28	20, 24	Gas	From metering station of Atlantic Seaboard Corp. to Washington to connect with line leading to District of Columbia facilities	$3.4 million	Authorized
Westcoast Transmission Company, Ltd.	270	8-26	Gas	Various locations in Peace River region	.....	Contracts let for 155 miles
Wilcox Trend Gathering System, Inc.	16	16	Gas	Gathering lines to Provident City, Texas	$2.9 million	Before FPC
Winnipeg and Central Gas Co.	450	4-8	LPG	Tioga, N.D.—Winnipeg, Canada	$20 million	Planned
Yacimientos Petrol. Fiscales	808	....	Gas	Campo Duran, to Buenas Aires, Argentina	$76 million	Planned
	635	....	Crude	Campo Duran to San Lorenzo, Argentina	$24 million	Planned
	621	....	Crude	Mendoza to San Lorenzo, Argentina	$19 million	Planned
Yacimientos Petro. Fiscales Boliv.	186	....	Crude	Camiri field to Santa Cruz, Bolivia	$4 million	Planned
	86		Crude	Yacuiba to Bermejo, Bolivia	$3 million	Considered

EMPRESA NACIONAL DEL PETROLEO of Santiago, Chile use their two Cleveland 320 trenchers on many different kinds of pipeline projects. Operating from Magallanes and Concon, the Clevelands dig a wide variety of trench lengths, depths and widths for crude oil, fuel oil, products and natural gas lines. The 320 shown here is digging a 17-kilometer crude oil line between ENAP's refinery at Concon and their Sea Terminal on Quintero Bay.

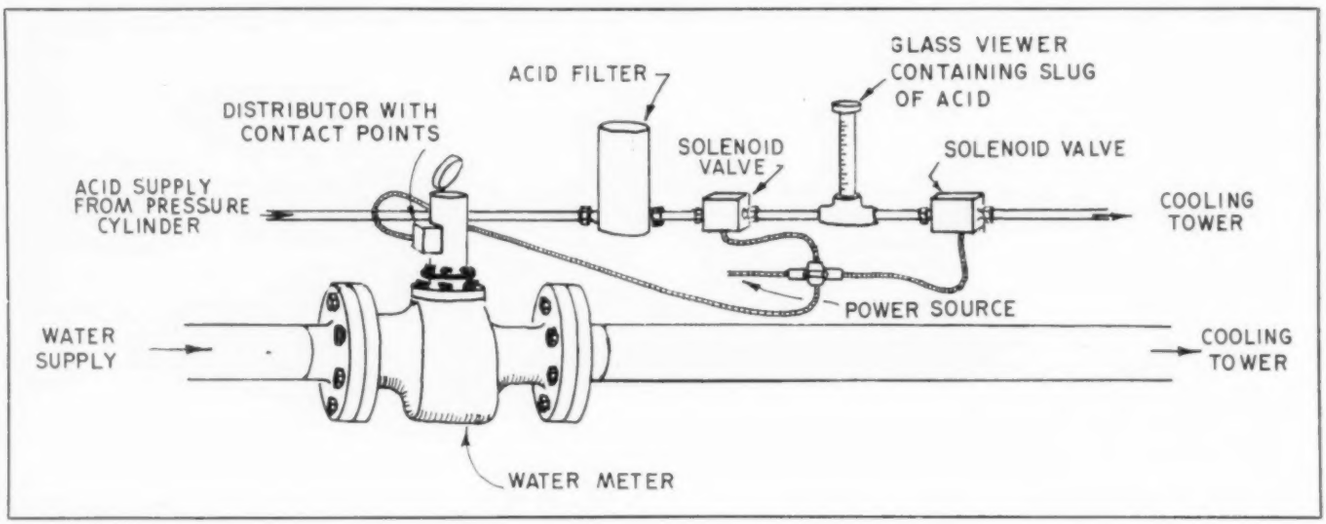
THE CLEVELAND TRENCHER COMPANY, 20100 St. Clair Avenue, Cleveland 17, Ohio

(Advertisement)

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas



Automatic System Adds Acid to Cooling Tower Water

This fully automatic acidizing system injects the proper proportion of acid into the water supply of a cooling tower no matter how the rate of flow of the water into the tower varies.

A water meter is installed in the water supply line to the cooling tower as shown. An extension is added to the top of the meter to allow installation of a distributor box which is actuated by the meter. When the meter records 1000 gallons as having passed through the line, the distributor is tripped and the meter goes on to record the next 1000 gallons to pass into the tower.

Actuation of the distributor closes an electric circuit which actuates two solenoid valves, forcing a predetermined amount of acid contained in a glass viewer into the water stream. The valves close immediately, allowing the glass cylinder to refill preparatory to the passage of another 1000 gallons of water into the tower.

The acid is stored in a pressurized tank and filtered before passing the first valve.

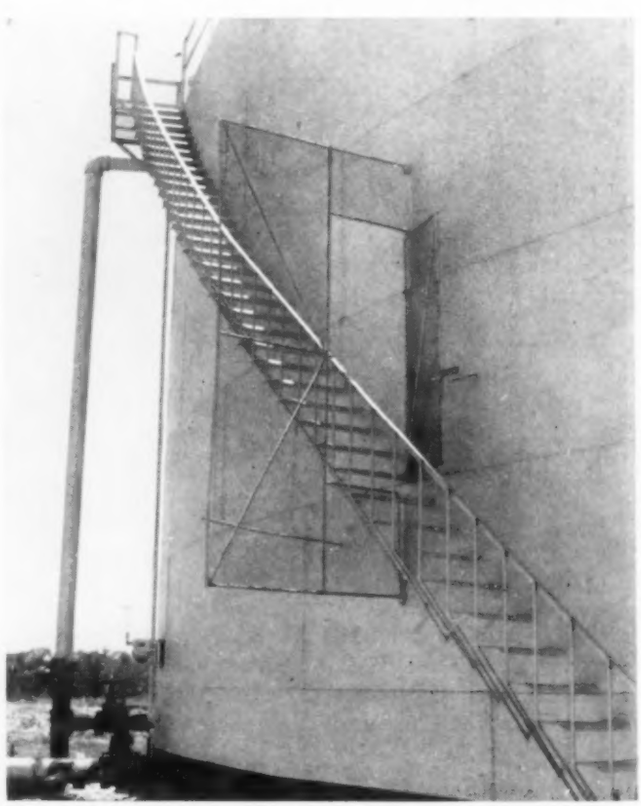
Keep Unauthorized Persons From Storage Tank Top

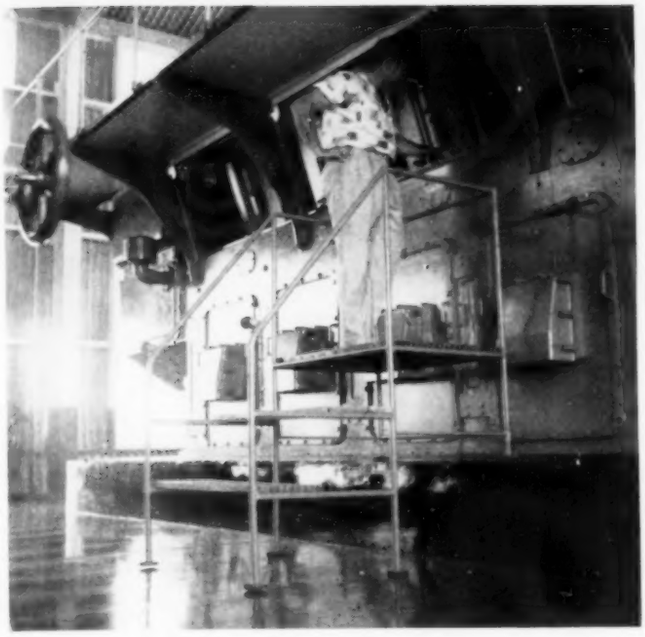
This specially-built gate will keep unauthorized personnel from getting on top of storage tanks. Accidents involving children and other unauthorized persons are thus kept to a minimum.

It is made of metal screen and one-inch pipe welded into a two-piece unit. One unit is the wall or gate casing; the other is the gate itself. A ring and hasp are welded to the installation so that the gate can be secured in the closed position with a padlock.

The screen wall shown is 9½-feet high and 5-feet wide with a gate opening 6½ by 2 feet cut 2 feet from the lower end. The gate is 6 by 2 feet. Wire is used to tie the screen to the pipe frames.

This assembly may be either tack-welded or bolted to the tank ladder steps and ladder rail.





Portable Stand Facilitates Engine Maintenance Jobs

Adjustable legs on this portable stand facilitate the maintenance man's job of getting at hard-to-reach places on the compressor engine for periodic maintenance.

The stand is made of 1-inch pipe welded as shown into a frame 3 feet wide and 7 feet in over-all height. Quarter-inch by 1-inch steel plate welded to the frame at 1½, 3 and 4½-foot heights form the steps and working base.

The front legs of the stand are cut about 2 feet shorter than the other legs. A section of ¾-inch pipe fits inside these legs and allows the stand to rest firmly on engine slabs up to two feet above the floor. A pin and chain attachment fits into holes drilled in this member to secure the legs at the proper height.

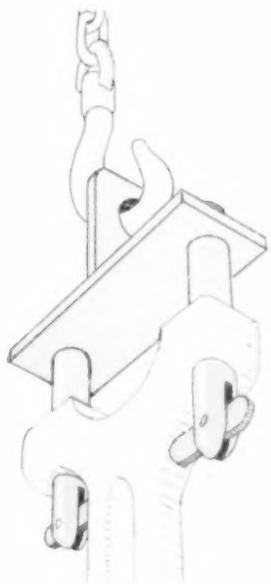
Small wheels welded to the hand rails facilitate moving the stand about the station by simply tipping the stand to rest on the wheels.

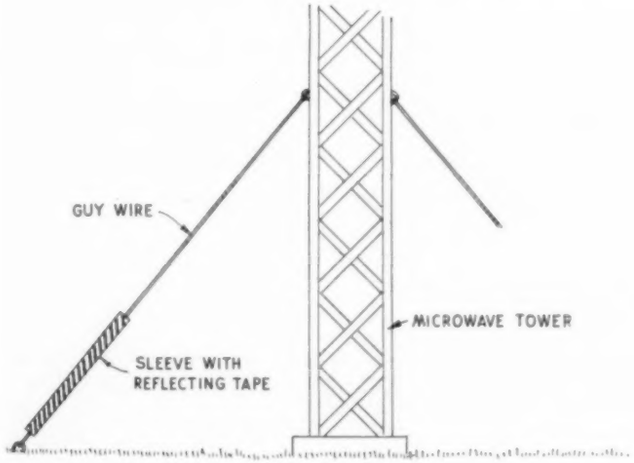
Tool Simplifies Pulling Piston Rods for Overhaul

This simple welded assembly speeds station engine overhaul by providing means of pulling piston rods quickly and easily.

The tool is made from two pieces of ½-inch plate and two rod "fingers" of proper diameter to fit into holes in the shoulder of the rod. Slots are cut in one end of the fingers and a pin driven through at right angles to hold a steel latch in the slot. The latch is free to rotate so that it can move from within the slot to a position at right angles to the fingers.

In use, the fingers are inserted in the piston rod shoulder and the latch rotated so that it holds the tool and rod together. A hook on the end of a chain hoist is attached to the other end of the tool, through a hole in the steel plate. A crane or chain hoist can then be used to pull the rod out of the engine. By turning the two latches, the tool can be released from the rod and used to pull another rod after the first has been released.





Shining Tape Reduces Risk Of Damage to Radio Towers

An effective method of preventing injury to personnel and damage to microwave and radio towers at night is to install reflective sleeves over the wires as shown.

Typical dangerous situations are trucks being routed near the guy wires at night and personnel walking in the vicinity when visibility is poor.

Accidents in these situations are reduced by making the guy wires glow with highly reflective taped sleeves fastened from the ground up to five or six feet. Reflective tape, attached to sleeves cut from plastic hose, will do the job.

20,772 hours...2½ years of trouble-free service at Plantation Pipe Line's Akron, Alabama, Station*

...typical of

JOHN CRANE 8-B

SEAL PERFORMANCE

***Case History**

"John Crane" Type 8-B Seals were installed in two high pressure 3-stage centrifugal pumps at the Akron, Alabama, Station, operated by Plantation Pipe Line Co. Pumps operated for 2½ years without shutdown. At the end of that time they were opened for inspection and parts repair. The seals, including rubber parts, were in perfect working condition. New 8-B Seals were ordered to insure repetition of this remarkable performance record. Old ones were rebuilt to serve as spares.

Here is further proof that wherever service is tough "John Crane" 8-B Seals are successfully doing the job. This is the reason why 75% of the seals installed in crude and product pipe lines within the last several years have been "John Crane" Seals.

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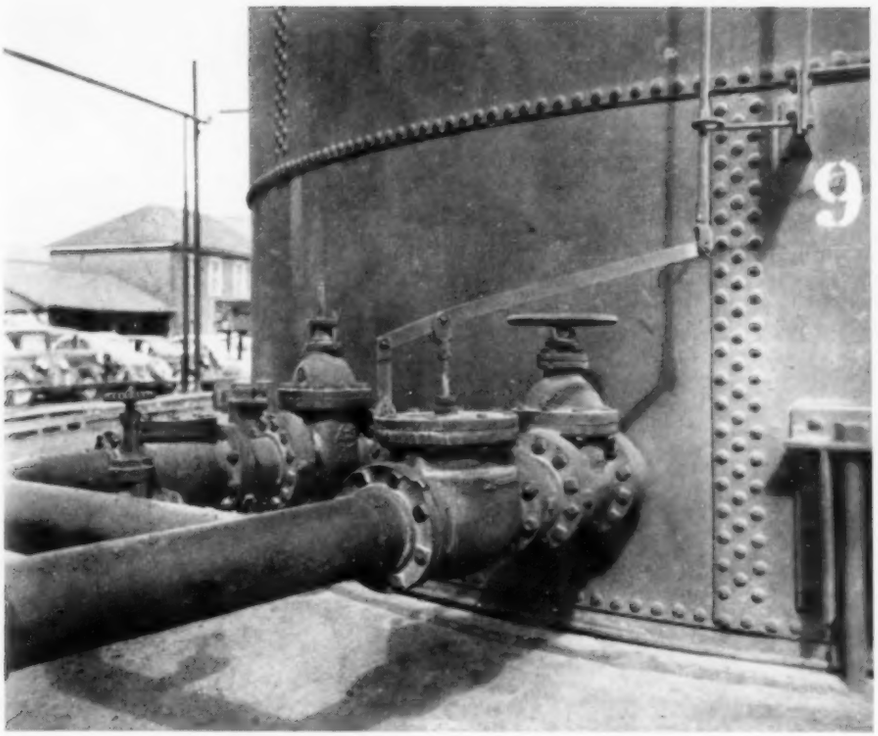

Surge Tank Has Novel Overflow Control

The valve arrangement shown automatically controls line surge pressures and surge tank overflow satisfactorily. The inlet valve in the foreground is connected in parallel to an outlet check valve.

This inlet valve allows oil to flow into the tank as long as the line pressure exceeds the liquid head pressure developed inside the tank by depth of the liquid. If line pressure remains higher than this head until an overflow condition is reached, a float mechanism closes the valve. Subsequent reduction of the line pressure below the head pressure causes the outlet valve to open and the liquid to pass back into the line.

The float mechanism consists of a float inside the tank, a lever attached to the inlet valve as shown and a rod and cable linkage connecting the lever to the float. The dead weight of the float is sufficient to hold the lever in an upward position and the inlet valve open.

This valve arrangement maintains continuous equilibrium between the tank and line pressures until the full capacity of the tank is reached.

Maintenance Truck Is Fitted for Many Jobs

The maintenance truck shown provides tools for almost any pipe line maintenance job.

The welding machine, several reels of cable, gas cylinders, and rubber hose will handle most welding and cutting jobs. A vise mounted on the rear of the truck is also handy in many field jobs. Small tools are carried in bins located under the truck bed. These spaces are provided by welding steel plate as shown.

A pipe base on the rear of the truck which permits rigging a boom for lifting and handling heavy objects and a trailer hitch are also provided.

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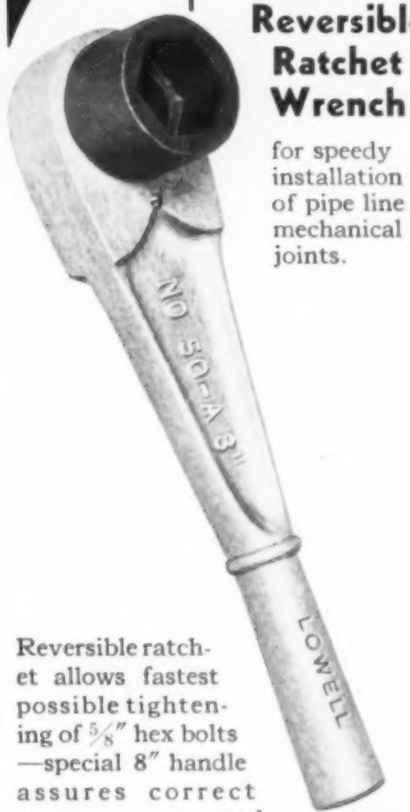
Lowell # 50-A Reversible Ratchet Wrench

for speedy installation of pipe line mechanical joints.



Reversible ratchet allows fastest possible tightening of 5/8" hex bolts —special 8" handle assures correct torque, as suggested in American Standard Specifications.

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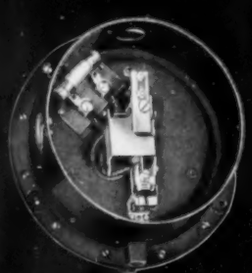

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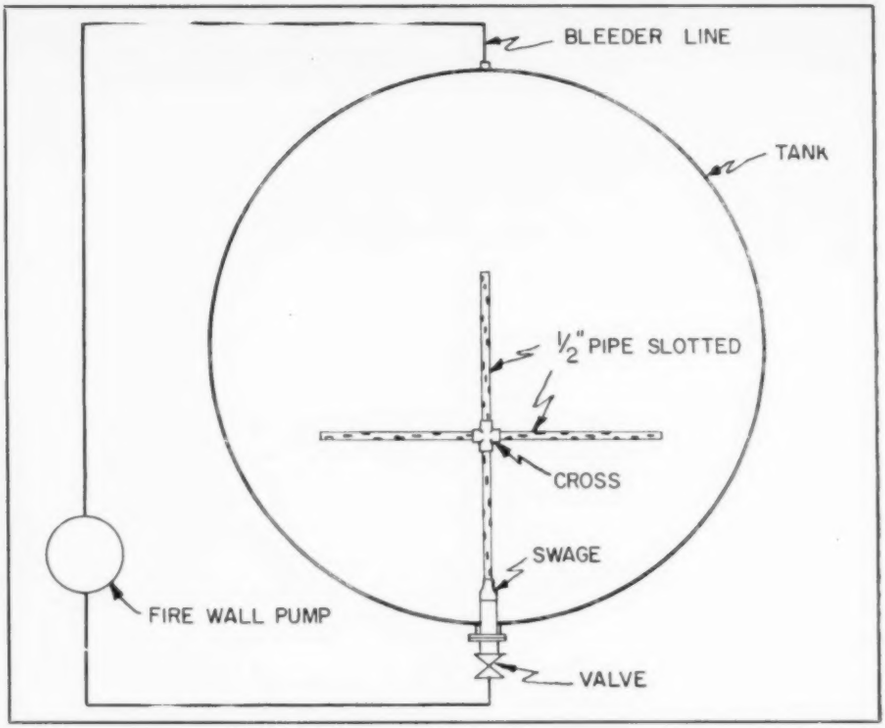

Spray Reduces Tank Cleaning Time

The time-consuming manual operation of cleaning small tank bottoms can be reduced by installing the assembly shown.

Install a flange near the bottom of the tank opposite the bleeder connection. By connecting the tank bleeder line to the suction of the fire wall pump and connecting the pump discharge to the flange, the fire wall pump can be used to agitate the tank bottom.

Connect a cross and four spiral slotted nipples to the tank flange as shown. Circulation through these slotted nipples will sufficiently agitate the tank bottom so that sediment can be removed through the bleeder line. If necessary, add a treating chemical to the tank while it is being agitated to assist in dissolving the congealed material at the tank bottom.

Work Table on Rollers Is Maintenance Aid

The work table shown here was fabricated at a compressor station to provide table space near the compressor and keep tools handy during maintenance jobs. A vise is mounted on top of the table as shown and tools are kept on the lower shelf of the stand.

Casters on the legs permit moving the table about the station for convenience during overhaul.

The entire assembly can be made from scrap materials in the station shop. During overhaul, it saves a lot of unnecessary steps and keeps tools handy.

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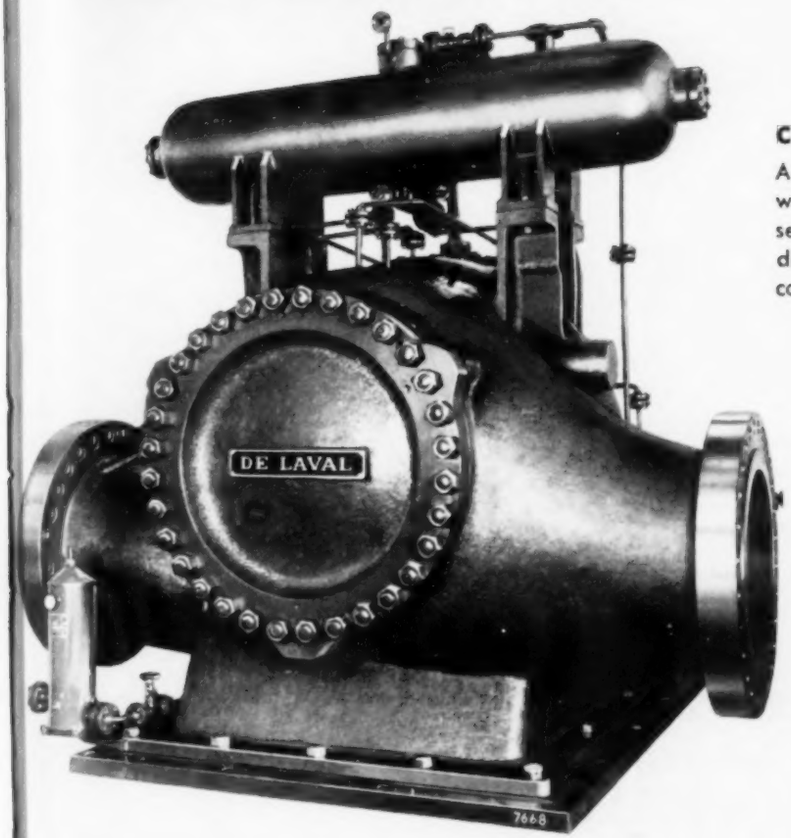
CENTRIFUGAL PIPELINE COMPRESSORS

come in two "packages" for easy installation



COMPRESSOR

A De Laval compressor with its emergency seal tank mounted directly on the compressor.

CONSOLE

The console contains the filters, motor-driven pumps, coolers, pressure switches, gauges and other accessories. It eliminates complicated piping on the packaged compressor . . . also serves as a protective cover for the equipment it houses.

Bulletin 503 gives data on De Laval centrifugal pipeline compressors. Write for your copy.

Designed in two packages, rugged De Laval centrifugal compressors offer many important engineering features. Among these are • high pressure contact shaft seal which eliminates gas leakage • heavy and rigid construction throughout • high load carrying capacity. The compressor and console arrangement makes De Laval centrifugal compressors easy to install—only simple low-cost foundations are required. De Laval units, totaling more than 280,000 horsepower, are now in operation on major pipelines.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY
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A Division of Sawyer-Tower, Inc.

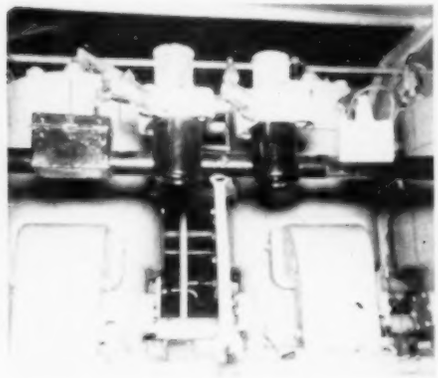
specialists in Protective Clothing for more than a century

8 Thorndike St., Cambridge 41, Mass.

Cart on Wheels Disposes Of Oil Filter Waste

At one South Texas compressor station the cart shown was fabricated from one-inch pipe to provide a frame for an oil filter waste container. The two rubber tires at the back and the small solid rubber guide wheel in front make the container easy to move around the station when cleaning out fuller's earth from oil reclaimers. The container, made from a discarded oil drum, has a flat plate welded across the bottom. Loop handles of steel rod are welded to the sides.

This equipment can be made quickly by welders at station shops and helps keep the station clean when handling oil filter charges. It is easily wheeled about the station for routine maintenance by one man.



Mount Spare Parts On Rail Near Engine

Mounting spare parts on hand rails next to the engine where they are needed can greatly reduce downtime at compressor stations during overhaul.

Shown from left to right are a metal box with hinged cover for a spare set of spark plugs, two holders for spare injection valves, a bracket for a spare spark coil and a wrench for setting tappet clearance. This installation, made at each engine, will save many steps by maintenance men.

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Crouse-Hinds — and only Crouse-Hinds — can provide positive protection *wherever* the merest spark can possibly occur in explosive atmospheres . . . from size 5 motor starters to sound-powered telephones. There are over 15,000 conventional and explosion-proof products in the Condulet line! They are available through your Crouse-Hinds distributor.

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WHAT'S NEW AT BRISTOL...

RIDING 250-MILE PIPELINE from his desk at Charlotte, N. C., Piedmont's gas dispatcher makes instant decisions with aid of this battery of 1- and 2-pen Bristol recorders. They show pressure, temperature and flow at 46 remote points.

Takes 46 readings over 250-mile pipeline with only 4 wire circuits

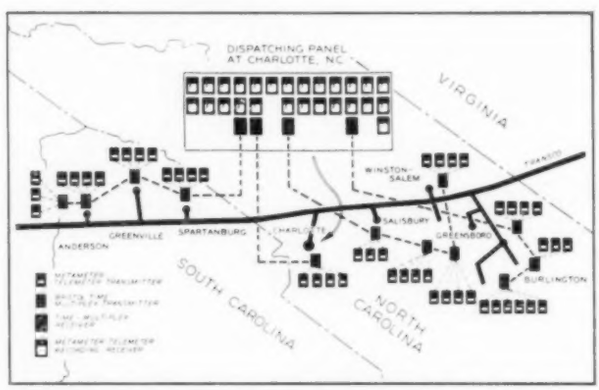
Piedmont Natural Gas Company is first to use new Bristol Intermediate Time-Multiplexing system

With the new Intermediate Time-Multiplexing system, only four leased wire circuits are needed to send readings from 46 telemeter transmitters along Piedmont's 250-mile pipeline to a central dispatching headquarters at Charlotte, N. C.

The close continuous supervision provided by the new Bristol instrumentation system enables operation of Piedmont's complex gas distribution facilities at nearly 99% load factor.

Multiplexed Bristol Metameter Telemeters provide transmission of up to 15 instrument readings over a single wire circuit. With the new Intermediate Time-Multiplexing, these readings may be multiplexed onto the line at *widely separated intermediate stations*—effecting great economies in the number of required circuits.

Find out how these Bristol Metameter Telemeters can solve *your* complex telemetering problem in the most economical manner. Write The Bristol Company, 114 Bristol Road, Waterbury, Conn. 5.45



TWO-STATE COVERAGE with only four leased telephone circuits is effected by this instrumentation system. Note that as many as four intermediate time-multiplex transmitters add readings to a single circuit at different points.

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POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Pipe Line Men

IN THE NEWS

Judge Arthur Kline of Cheyenne, Wyo., has taken oath of office as a member of the **Federal Power Commission** succeeding **Claude L. Draper.** Kline has served as assistant attorney general of Wyoming, deputy secretary of state, city attorney of Cheyenne, and commissioner on Uniform State Laws from Wyoming. In 1953 he was appointed judge of the First Judicial District of Wyoming and elected to a six-year term in 1954. He resigned as judge to take office as a member of the FPC.

•

Ivan M. Cook, Long Beach, has been named Pacific Coast superintendent of communications for **Shell Oil Company's** Pipe Line department. Cook joined Shell in 1928 as a telephone electrician's helper at the company's refinery at Dominguez, Calif. He later served as telephone foreman and communications engineer, and telephone superintendent for Shell pipe lines' Pacific Coast communications system before his promotion.

•

Donald W. Weir has been named assistant to the president of Arkansas Louisiana Gas Company. **J. C. Hamilton.** Weir will be in charge of personnel, employe welfare and training, safety programs, community relations, wage and salary administration, labor relations, organization problems and efficiency studies. Since joining Arkansas Louisiana, Weir has served as junior engineer and for the past three years has been personnel manager.

•

The British American Oil Company Limited has announced the election of **E. D. Loughney,** formerly vice president of Canadian Gulf Oil Company, as a director and has been appointed vice president of British American Oil with headquarters in Toronto. Loughney will be responsible for the executive direction and control of British American's exploration, production and pipe line activities in Canada. **O. I. Torkelsen** has been appointed vice president and general manager of The British American Oil Company Limited's enlarged exploration, production and pipe line operations in Western Canada, including those formerly conducted by Canadian Gulf Oil Company. He will continue to make Calgary his headquarters.

•

John W. Hawkins has been named manager of planning and development for **Mid-Continent Pipe Line Company.** Hawkins came to Mid-Continent from Service Pipe Line Company where he worked as junior engineer, engineer, planning engineer and district engineer in Tulsa and in Texas from 1948 to 1956. His appointment to the newly created position is part of Mid-Continent's previously announced program of expansion.

John W. Hawkins

•

Coastal Transmission Corporation has announced the election of **W. J. Bowen** as president and chief executive officer. **John O. Sue,** president of the company since its organization two years ago, was elected chairman of the board. Bowen joined the engineering staff of Delhi-Taylor Oil Corporation, Coastal's parent company, in 1949. He was promoted to assistant sales manager in 1955 and elected a vice president of Coastal two years ago. Sue, a former executive of the Humble Oil & Refining Company, was assistant production manager in charge of the Gas department at the time of his retirement from that company in 1954.

•

Neal Hall and **Jim Carll** have been appointed advertising director and public information director for **Lone Star Gas Company. L. C. Roberts,** former advertising director, has been granted an extended leave of absence.

Jimmy Demaret

Jackie Burke, Jr.

Robie Williams

W. C. Hilliard

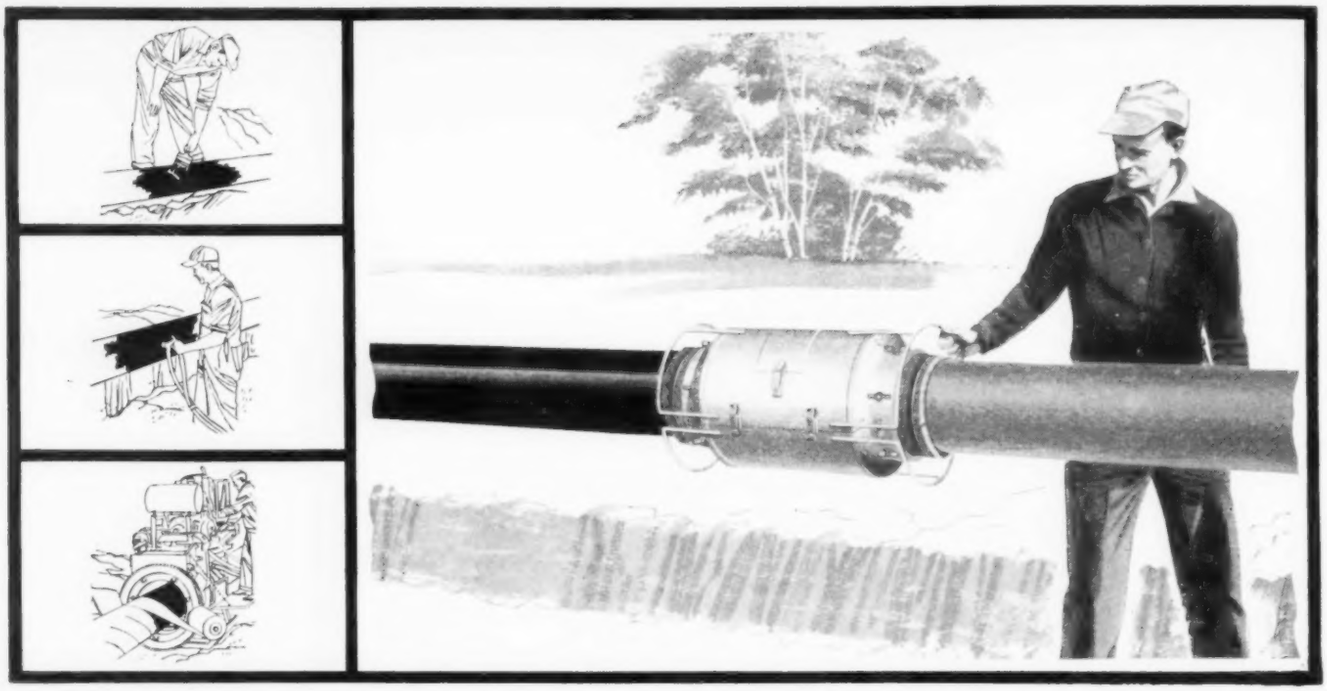
Par-Constructors Inc., a new pipe line construction firm, has been organized in Houston to engage in the construction of main cross country pipe lines, city distribution systems, laterals and take-up lines, as well as station construction.

Three men well known in professional golfing circles head the new firm. **Jimmy Demaret** is president; **Jackie Burke, Jr.,** vice president; and **Robie Williams,** treasurer. **W. C. Hilliard,** a 20-year veteran in the field of general and pipe line construction, is general superintendent for Par-Constructors. Hilliard has worked as welder, foreman and field superintendent on major pipe line jobs as well as engaging in general construction work.

An office will be opened in Houston. The mailing address is P. O. Box 7744.

•

Robert E. Hill, assistant manager of public and industrial relations for **Cities Service Gas Company,** Oklahoma City, has been transferred to a new Cities Service affiliate at New Orleans. Hill will be in charge of industrial relations for Petroleum Chemicals Inc., owned jointly by Cities Service Company and Continental Oil Company. With Cities



ROSKOTE Cold Applied Pipe Mastics

EASY TO APPLY—FAST DRYING—HIGH ELECTRICAL RESISTIVITY

Because of their ease of application and extremely fast drying time — because they possess the highest electrical resistivity of any cold coating and offer the least amount of objectionable fumes and skin irritants — Roskote pipe mastics have been field approved by more and more leading utilities each year.

In fact, Roskote has been specified by over 200 oil and gas companies for the protection of their natural gas, oil and product pipelines.

A new folder on Roskote, which includes a complete description of its properties, application instructions and full test data, is now available. The test data is of special importance because it gives specific figures on volume resistivity during and after drying.

For a copy of this new folder on Roskote or literature on any other Royston product, just drop a line to Royston Laboratories or any of its district sales offices.

ROYSTON LABORATORIES, INC.

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Distributors Of

Polyken Tape
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Glass Pipe Wrap
Pipeline Padding

Warehoused in North East, South East, South Central and North Central Regions

Service Gas Company since March, 1950, Hill has served two years at the company's operations office in Wichita and the past three years in the Oklahoma City office.

•

R. B. Gaines has joined the Gas Reserves and Availibility Section of the Gas Supply department of **Northern Natural Gas Company** as geological engineer. Gaines has eight years experience in the petroleum industry, working as a geologist and a geophysicist. He was with National Geophysical Company of Dallas, Texas, and Stanolind Gas and Oil Company of Houston as a geophysicist, and was a geologist for Ohio Oil Company and Southern California Petroleum Corporation in Midland.

R. B. Gaines

•

R. K. (Bob) Andersen, Houston, has been named assistant personnel director of **Transcontinental Gas Pipe Line Corporation.** Andersen came to Transco in 1950. Earlier assignments include payroll, internal accounting control and special duty in the Pipe Line department.

•

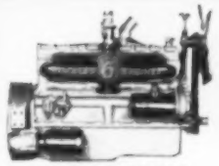
Clyde O. Johnson has joined the administrative office of **International Petroleum Company, Limited,** as transportation advisor. After serving Interstate Oil Pipeline Company from 1946 to 1952 in Tulsa, Okla., and Brookhaven, Miss., Johnson transferred to Standard Oil Company (N. J.) in November, 1952, to accept the position of engineer in the Transportation Coordination department.

Clyde O. Johnson

•

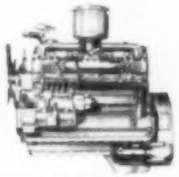
The Service Pipe Line Company has acquired the crude oil transportation facilities of the Pan-Am Southern Corporation. Pan-Am's Louisiana and Arkansas purchases will be added to Service's East Texas division. The Pan-Am Southern acquisition will be

This is HERCULES MOTORS Today

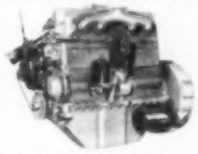


L-HEAD GASOLINE

OVERHEAD-VALVE GASOLINE



TURBULENCE-CHAMBER DIESEL



DIRECT-INJECTION DIESEL

TURBOCHARGED DIESEL

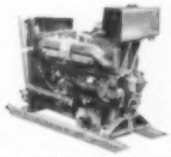
DEPENDABLE POWER FOR INDUSTRY

TRANSPORTATION AGRICULTURE CONSTRUCTION INDUSTRIAL MARINE OILFIELD

Yes, this is Hercules Motors, today—all types of dependable power for modern industry. The Hercules line includes more than 90 different models of engines and complete power units ranging from 3 to 500 H.P.

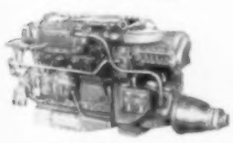
An ever-growing list of customers are solving their power problems with these types of Hercules Engines: L-head gasoline, overhead-valve gasoline, natural gas, L.P.G., turbulence-chamber diesels, direct-injection diesels, Turbo-Charged Diesels, marine diesels and complete open, closed and base type power units.

Write for more information on any of these dependable power plants. Our sales-engineers will be happy to help solve your power problems. No obligations, of course.



L.P.G. OR NATURAL GAS

POWER UNITS



MARINE DIESELS

HERCULES MOTORS CORP.

Engine Specialists Since 1915 • Canton, Ohio

under the supervision of **G. G. Moore** and will be a new district with headquarters at El Dorado. The southern Louisiana purchases have been set up as a new district with **John A. Grant,** Beaumont, as district superintendent. The changes are part of a plan announced by Standard Oil Co. (Indiana) to consolidate a number of subsidiary companies engaged in similar functions.

•

John C. Boehm has been named assistant superintendent of compressor stations for **Transcontinental Gas Pipe Line Corporation.** Boehm fills the position vacated by **Howard L. Cline,** who became superintendent two months ago. Boehm, now assistant personnel director, has been with Transco since 1950. Prior to his position in Houston with the Personnel department, Boehm served two years as superintendent of Transco's compressor division III with headquarters at Charlottesville, Va.

C. L. Wilson

James J. Dougherty

C. L. Wilson, Service Pipe Line Company district superintendent at Kearney, Neb., has been transferred to Mineral Wells, Texas, replacing **James J. Dougherty,** who retired June 30. Dougherty, former superintendent of the Mineral Wells district since 1953, joined the company in 1916 and is the first Service Pipe Line Company employe to retire with 40 years service. Wilson has been with the company since 1924. He served as an operator-gager and station engineer and became district foreman at Topeka, Kansas, in 1948. Later that year, the Nebraska division was divided into three districts and Wilson took over the Kearney district. In 1955, the Nebraska division was discontinued with the completion of Service's 20-to-24-inch crude line from Wyoming to Missouri. For the past year Wilson has been in charge of disposing of facilities made idle by the new line.

•

J. E. Heston of Bartlesville, Okla., has been elected president of **Arkansas Fuel Oil Corporation** succeeding **Robert L. Kidd,** who resigned to accept the presidency of **Cities Service Oil Company (Delaware).** Heston was vice president of Cities Service Oil Company (Delaware). Heston and Kidd have been associated with the Cities Service system for many years, both having experience in oil and natural gas exploration and production.

•

Paul L. Davies, San Jose industrialist, has been elected to the board of directors of **Pacific Gas and Electric Company.** Davies, who is chairman of the board and chief executive officer of Food Machinery & Chemical Corporation, San Jose, fills a vacancy on the board created by the resignation of **John P. Coghlan,** who was a director for the past 25 years.

ARCCO
The World Over
—wherever there is gas
ARCCO-ANUBIS
'Dry-Air GAS
GRAVITOMETERS
This new Arcco-Anubis Dry Air Gas Gravitometer determines and records specific gravity of gases automatically corrected to the humidity content of the air. The difference in weight between a column of GAS and equal column of DRY AIR is measured. This ratio represents the true specific gravity of the sample.
One bell of the instrument is filled with gas which is being measured, and the other bell is filled with dry air. Otherwise, except for the new instrument having one column for gas and one column for dry air, the unit is identical in operation to the standard gas gravitometer. When calibrated and properly installed, these instruments require little attention other than to wind the clock, ink the pen, and change the chart. Send for bulletin No. 101.
AMERICAN
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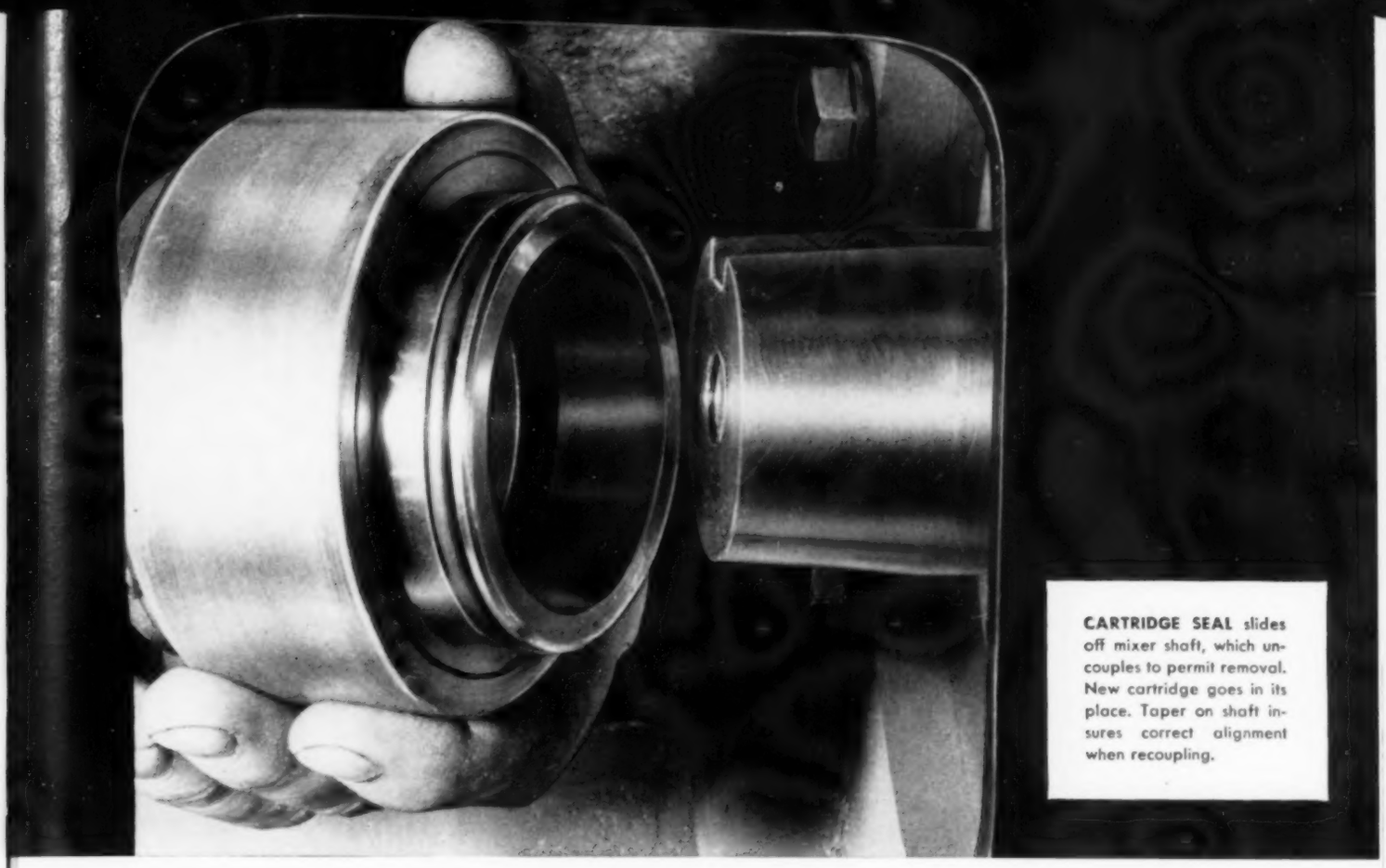

CARTRIDGE SEAL slides off mixer shaft, which uncouples to permit removal. New cartridge goes in its place. Taper on shaft insures correct alignment when recoupling.

Cut mixer maintenance 60%

with this cartridge-type *rotary seal*

Stops leakage! Runs years without adjusting! Slides off for fast, easy replacement!

If you're mixing or blending in big tanks, here's the newest way to slash mechanical mixer upkeep as much as 60%.

For here at last is a rotary mechanical seal—optional on new LIGHTNIN Side Entering Mixers—that stops leakage around the tank, ends stuffing-box repacking and adjusting for good.

And for the first time ever on big-tank mixers, you can replace this seal in a jiffy if you ever have to! No need to dismantle or remove the mixer from the tank. No need to drain the tank. No special skill required!

Even under a full head of liquid in the tank, the seal-change job is so simple it takes only minutes. The mixer shaft retracts to seal the tank, then uncouples. The seal cartridge slides off in one piece. A new cartridge slides on; the mixer shaft automatically realigns itself when recoupled—and you're back in operation.

The LIGHTNIN seal cartridge is a complete unit assembly, easy to stock as a replacement, or quickly obtainable in all sizes and materials, for the simplest or most difficult operating conditions.

Already, many oil companies are using LIGHTNIN Seals—and saving many thousands of dollars per year. Your LIGHTNIN Mixer representative can give you the full story—show you how much *you* can save. Call him today—he's listed in your copy of Refinery Catalog. Or get the facts by mail: send the coupon for 8-page, fully illustrated bulletin.

Lightnin® Mixers

MIXCO fluid mixing specialists

Left: **NO STUFFING BOX** to repack or adjust. No leakage around the tank. When correctly applied seal runs for years without adjustment. *Right:* **REPLACEMENT** is simple, even with tank full. Mixer shutoff closes like a valve to keep liquid in the tank while seal is being changed.

☐ ***Quick!*** **Send us the cost-cutting facts on LIGHTNIN Rotary Mechanical Seals—Bulletin B-111. We'd also like catalog information on these LIGHTNIN Mixers:**

- ☐ B-102 Top or bottom entering; turbine, paddle, and propeller types: 1 to 500 HP
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Check, clip, and mail with your name, title, company address to:

MIXING EQUIPMENT Co., Inc., 196-j Mt. Read Blvd., Rochester 11, N.Y.

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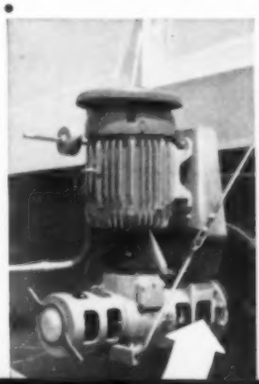
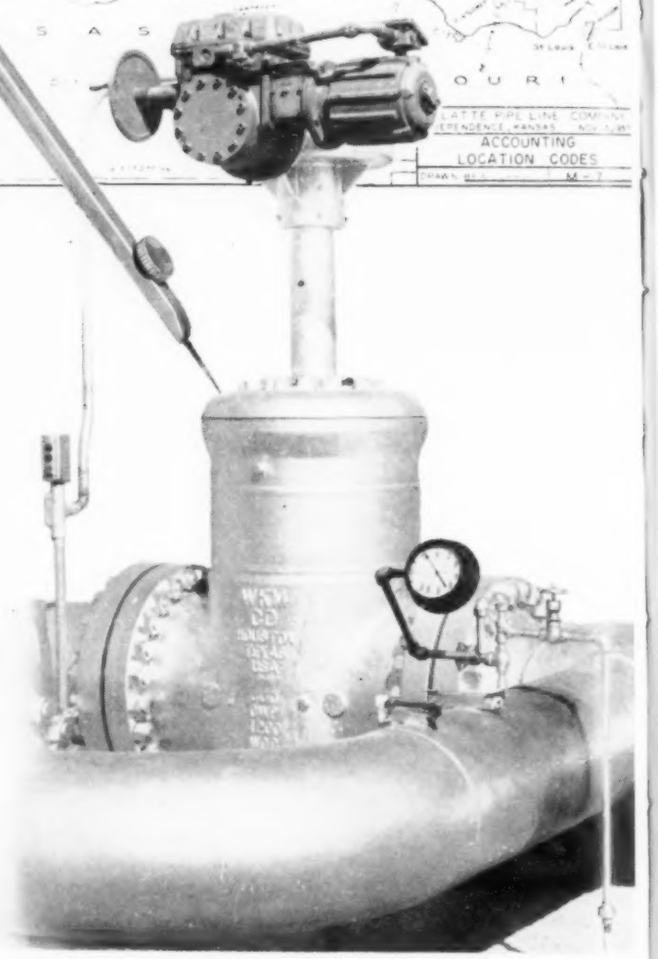


1,075 Controlled Miles



From Worland, Wyoming, to Wood River, Illinois — 1,075 miles, it is ***E-I-M*** all the way.

Some unique engineering steps were pioneered on the Platte Pipe Line, which covers five states and crosses two of the largest rivers in the United States, the Missouri and the Mississippi. It is one of the largest and longest crude oil carriers ever constructed, with 14 pumping stations along the line, and E-I-M Valve Controls are being used exclusively from end to end. There are more than 200 E-I-M Valve Controls of various types on this 16" and 20" line.

All over the world, ***E-I-M Valve Controls*** are the guardians of the oil and gas industry's life lines, of which Platte Pipe Line is a mighty artery.

Progressive Pipe Liners Specify E-I-M VALVE CONTROLS

E-I-M Company INCORPORATED

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Valve Controls • Speed Reducers • Cooling Tower Drives • Control Valves

Fred H. Warren, former general superintendent of the Eastern Pipe Line divisions of **The Ohio Oil Company,** is manager of the newly created Operations Planning department. Warren joined Ohio in 1939 as assistant chief engineer for the subsidiary, Illinois Pipe Line Company. He later was general superintendent of trunk and gathering pipe lines east of the Mississippi and in 1947 was named general superintendent of eastern pipe lines.

F. H. Warren

•

T. H. Atkinson, M. C. of Montreal, former vice president and general manager of The Royal Bank of Canada, has been elected a member of the board of directors of **Trans-Canada Pipe Lines Limited** and appointed chairman of the company's finance committee. Atkinson continues to serve on the board of directors of the bank and he is also a director and member of the executive committee of the Montreal Trust Company.

WHO'S MEETING WHERE

September

Independent Natural Gas Association of America, St. Anthony Hotel, San Antonio, Sept. 9-11.

Short Course in Corrosion, Dept of Metallurgical Engineering, College of Engineering, The Ohio State University, and the National Association of Corrosion Engineers, Ohio State University, Columbus, Sept. 10-14.

Pacific Coast Gas Association, Annual Meeting, Coronado, Calif., Sept. 11-13.

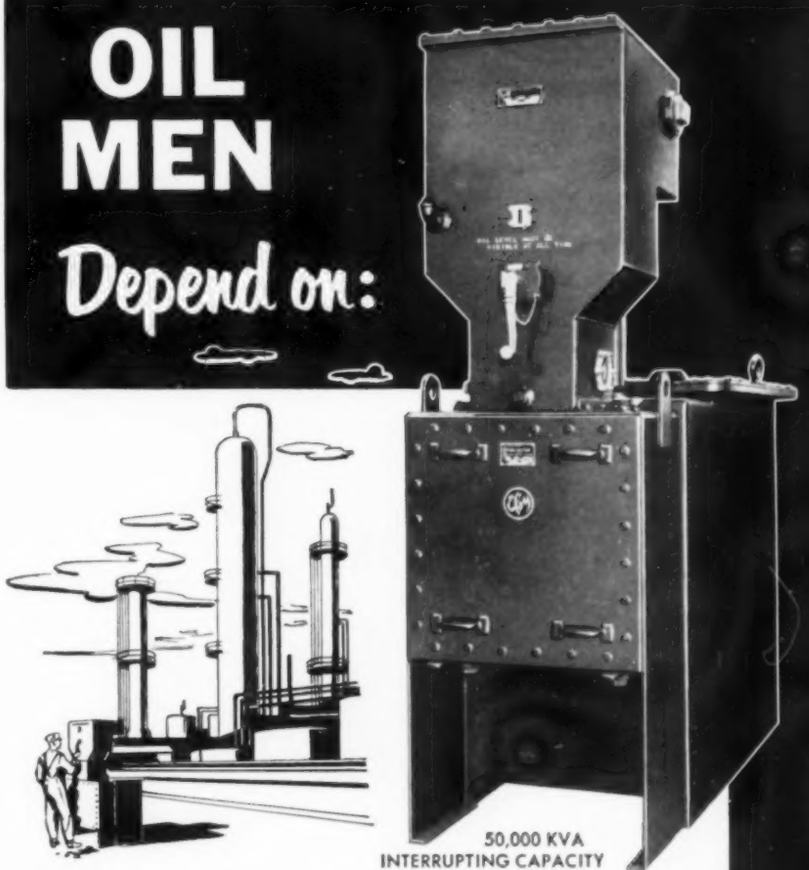
Mid West Gas Association Gas School and Conference, Iowa State College, Ames, Iowa, Sept. 12-14.

AIEE, Electrical Conference of Petroleum Industry, Muehlebach Hotel, Kansas City, Mo., Sept. 17-19.

American Society for Testing Materials, Pacific Coast Meeting, Hotel Statler, Los Angeles, Calif., Sept. 16-22.

Instrument Society of America, Instrument Automation Conference and Exhibit, New York Coliseum, New York, Sept. 17-21.

OIL MEN Depend on:



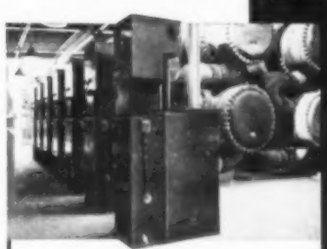
50,000 KVA INTERRUPTING CAPACITY

EC&M 2200-5000 VOLT Motor Starters

These EC&M Div. 1 combination Starters for Class I, Group D locations give refinery engineers and construction and design companies top value. They require less floor space . . . line, motor and control leads are brought to conduit connection box for quick installation . . . and high interrupting capacity is inherent . . . 50,000 KVA, and no fuses required.

Oil disconnect switch (on top) may be locked open or closed . . . view windows on both sides show switch contacts. Rear oil-tank has potential transformer for 220-volt push button circuit. Type ZHS (50,000 KVA) Magnetic Contactor may be raised above oil for inspection without disconnecting any bolts or leads.

Before buying, investigate EC&M Combination Starters . . . they provide economy in installation, operation and maintenance . . . and they're complete in every respect.



ADVANTAGES of this Battery of EC&M Starters in a refinery.

1. Combination Starter with self-contained Oil Disconnect Switch
2. All internal wiring complete . . . leads brought to conduit box for easy connection to power and motor leads
3. Heavy duty contactor has alloy contacts
4. Slender design reduces floor space
5. Thermal-Magnetic Overload Relays give accurate motor protection . . . trip instantly on faults
6. Simple 3-wire time-delay UVP push button circuit

Write for descriptive Booklet 1062-VIII

SQUARE D COMPANY

EC&M DIVISION • CLEVELAND 28, OHIO

6722

Southeastern Gas Association, Hotel Sir Walter, Raleigh, N. C., Sept. 19-21.

Shreveport Section, NACE, 6th Annual Corrosion Control Short Course, Centenary College, Shreveport, La., Sept. 20-21.

Mid-Continent Oil & Gas Assoc., Louisiana-Arkansas Division, Annual Membership Meeting, Roosevelt Hotel, New Orleans, Sept. 20-21.

Products Control and Dispatching Group, 7th Annual Meeting, Lennox Hotel, St. Louis, Mo., Sept. 22-23.

American Society of Mechanical Engineers, Petroleum Mechanical Engineering Conference, Statler-Hilton, Dallas, Sept. 23-26.

API Executive Committee of the Board of Directors, Greenbrier Hotel, White Sulphur Springs, W. Va., Sept. 26.

International Gas Union, Sixth Annual Conference, Hotel New Yorker, New York City, Sept. 25-30.

October

American Institute of Electrical Engineers, Morrison Hotel, Chicago, Oct. 1-5.

Texas Mid-Continent Oil & Gas Association, Rice Hotel, Houston, Oct. 2-3.

American Society of Mechanical Engineers and American Society of Lubrication Engineers, Lubrication Conference, Chalfonte-Haddon Hall, Atlantic City, N. J., Oct. 8-10.

Gas Measurement Institute, University of Kansas and Southwest Kansas Petroleum Industry, 4-H Building, Liberal, Kansas, Oct. 9-10.

Oil Progress Week, Oct. 14-20.

AGA Annual Meeting, Atlantic City, N. J., Oct. 15-17.

American Society of Civil Engineers, Pipe Line Division, William Penn Hotel, Pittsburgh, Oct. 15-19.

American Institute of Mining, Metallurgical and Petroleum Engineers, Petroleum Branch, Biltmore Hotel, Los Angeles, Oct. 15-17.

American Society of Civil Engineers, Annual Convention, William Penn Hotel, Pittsburgh, Oct. 15-19.

Rocky Mountain Oil & Gas Association, Annual Convention, Cosmopolitan Hotel, Denver, Oct. 22-24.

National Safety Council, Chicago, Oct. 22-26.

American Society of Safety Engineers, Annual Meeting, Conrad Hilton Hotel, Chicago, Oct. 23.

National Association of Corrosion Engineers, South Central Region, Gunter Hotel, San Antonio, Texas, Oct. 23-26.

Independent Petroleum Association of America, Annual Membership, Mayo Hotel, Tulsa, Oct. 25-26.

November

American Petroleum Institute, Annual Convention, Conrad Hilton Hotel, Chicago, Nov. 12-15.

American Society of Mechanical Engineers, Statler Hotel, New York, Nov. 25-30.

January

Pipe Line Contractors Association, Ninth Annual Convention, Boca Raton Hotel and Club, Boca Raton, Fla., Jan. 14-16, 1957.

American Institute of Electrical Engineers, 1957 Winter General Meeting, Hotel Statler, New York, Jan. 21-25.

March

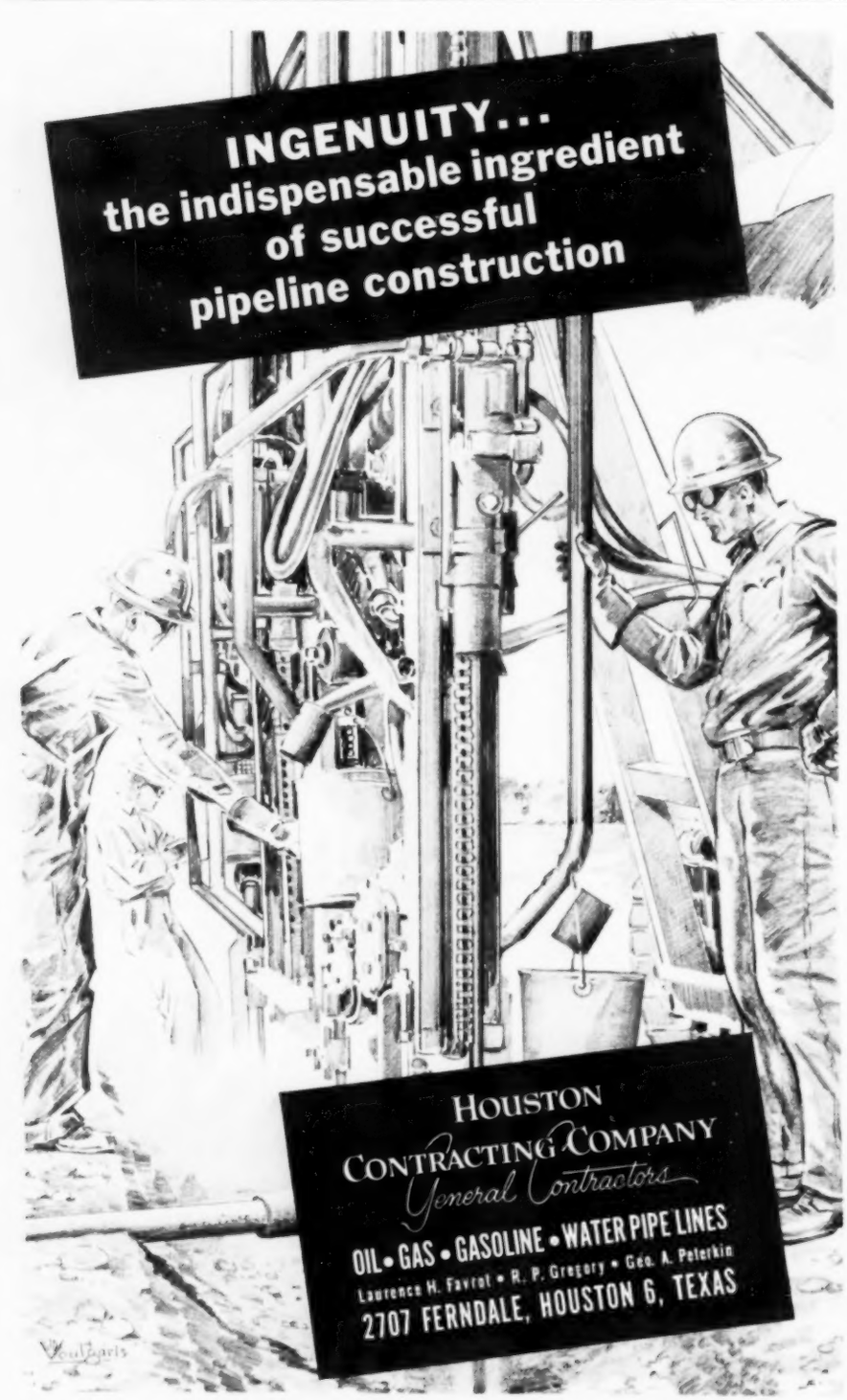
NACE, 13th Annual Conference and Exhibition, St. Louis, Mo., March 11-15, 1957.

New England Gas Association, Annual Meeting, Hotel Statler, Boston, Mass., March 21-22, 1957.

April

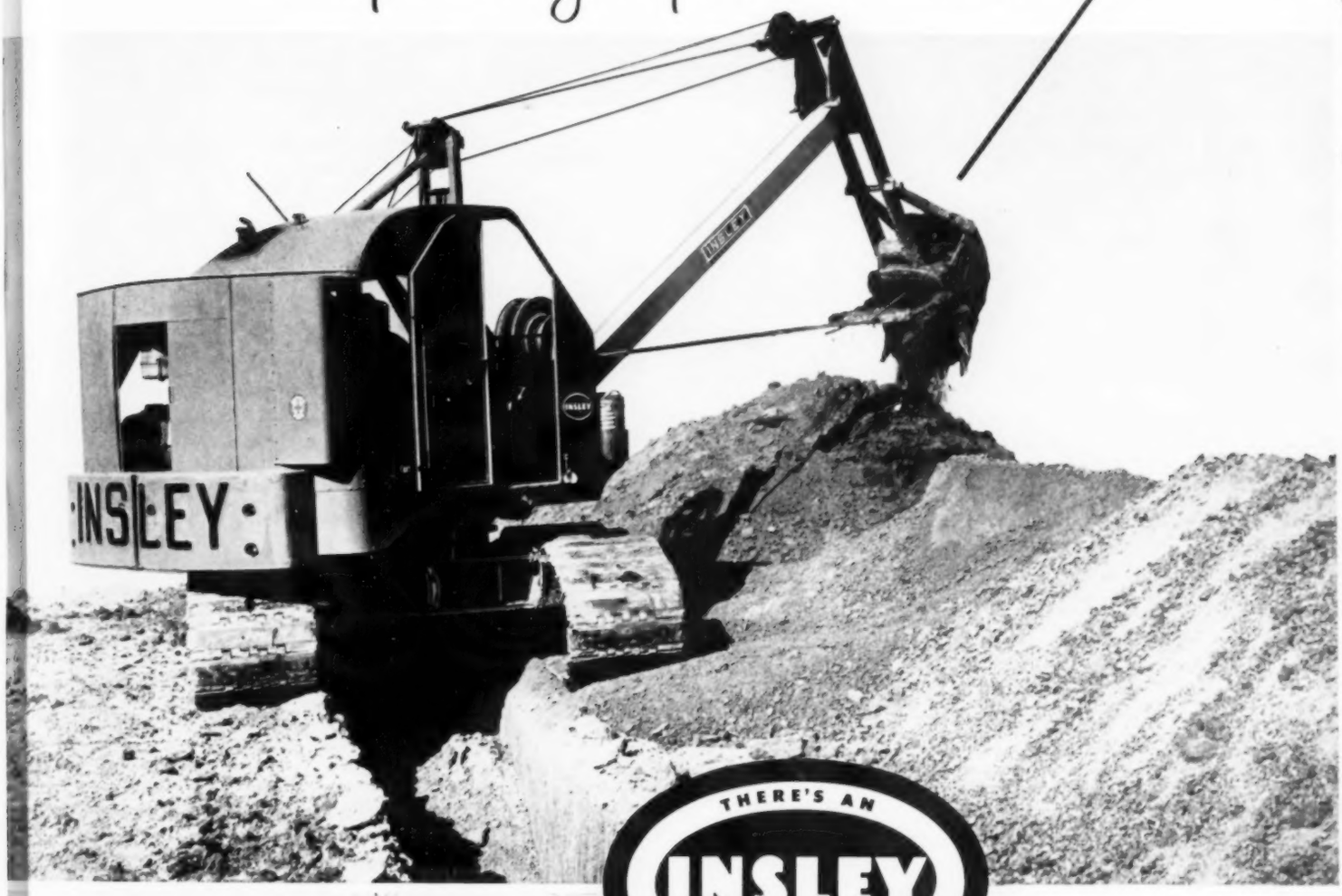
Petroleum Equipment Suppliers Association, Palm Springs, Calif., April 6-11, 1957.

American Welding Society, Sheraton & Bellevue Stratford Hotels, Philadelphia, April 8-12.



the INSLEY "pipeliner"

...as requested by Pipeline Contractors



THERE'S AN **INSLEY** WORKING NEAR YOU

The Insley "Pipeliner" is the hard-working answer to the contractor's need for a machine especially designed for pipeline work . . . a machine with "built-in" durability and stamina that will withstand the severe operating conditions of cross-country pipelining.

- **New, wide, deep carbody with removable bottom cover plates**
- **Crawler rollers and tumblers sealed against dirt**
- **Two-speed travel (optional) through two-speed transmission .8 M.P.H. and 1.6 M.P.H.**
- **Increased stability and flotation with 12'-6" crawlers and 24" or 30" shoes**
- **Long wearing, heat-treated, alloy steel crawler shoes and pins**

The "Pipeliner" is fully convertible for hoe, shovel, dragline, clamshell and crane work, and is available with gasoline or diesel power. See your Insley distributor for full details or write direct to Insley.

INSLEY MANUFACTURING CORP. · INDIANAPOLIS, IND.

***Wholly owned subsidiary* / THE MAXI CORP. · LOS ANGELES**

What's Happening

AMONG SERVICE AND SUPPLY MEN

W. W. Cabell

L. V. Orton

Fred Crabbe

Jerry Stebbins

Norvell F. Slay

C. E. Anderson

New Vice Presidents Named By C. A. Mathey Machine Works

William W. (Bill) Cabell has been appointed vice president and general sales manager for the C. A. Mathey Machine Works, Inc. in Tulsa, and L. V. Orton, promoted to vice president in charge of development and production.

Cabell is replacing George L. Temple, now general manager of Reading and Bates Offshore Drilling Company. Cabell was former treasurer of Mathey and has been with the firm since the new managership was taken over by O. F. Dickenson. Before employment with Mathey, Cabell was with Buda Engine Sales and Service.

Orton was formerly plant superintendent and has been with C. A. Mathey 30 years. He is experienced in the specialty equipment business, both in field problems as well as plant production.

Crabbe and Stebbins Appointed To Represent Fisher Governor

Fisher Governor Company has appointed Fred Crabbe and Jerry Stebbins sales representatives for New York and the surrounding territory. Their organization will be known as Crabbe & Stebbins Company, with offices located in Englewood Cliffs, N. J., and Albany, N. Y.

Crabbe joined the Fisher sales organization in 1943 and has been in New York since 1945. Stebbins entered the New York sales office in 1947.

Lynn Maxwell and William Conway have also joined the company. Maxwell, who has two years sales experience with Fisher, will devote his attention to gas distribution equipment. He will work out of the New Jersey office. Conway has been with Fisher since 1953 and will head the Albany office.

Slay and Anderson Receive Appointments at W-K-M

Norvell F. Slay has been appointed purchasing agent and Clifford E. Anderson named chief research and development engineer for W-K-M Manufacturing Company, Inc.

Slay was factory manager of the former Key Company, having been with the firm 22 years. Anderson, who joined W-K-M in January of this year, was formerly senior development engineer with Cameron Iron Works and for the past two years was an independent consulting mechanical design engineer, specializing in oil industry design problems.

3 Pipe Equipment Concerns Open Branch in Portland, Ore.

A new branch office and warehouse has been opened in Portland, Ore. for Midwestern Pipe Line Products Co., Midwestern Engine & Equipment Co., Inc., and Midwestern Manufacturing Company, all of Tulsa. The new office will be headed by E. J. Spradlin as sales-service representative. Spradlin was formerly attached to the firms' Oklahoma City office.

The Midwestern companies are distributors of pipe wrapping materials and pipe line construction equipment, with offices in Houston, Atlanta, Pittsburgh, Oklahoma City and Mt. Prospect, Ill.

The Portland warehouse will stock small tools and equipment and repair parts for operating companies and pipe line contractors in the Northwest territory.

Jones & Laughlin Supply Moves Sales Office and Store

Jones & Laughlin Supply division has moved its Kansas district sales office from the Union National Bank building to Union Center building in Wichita, Kansas.

Under the direction of J. A. Carrigan, district sales manager, the Wichita office is central headquarters of the firm's Kansas district operations including supply stores at Chase, El Dorado, Great Bend, Hill City, McPherson, Russell and Winfield.

The firm's oil field supply store in Wichita Falls, Texas, also has moved to a new location. The new building houses an office, an Axelson pump repair shop and a warehouse. Personnel assisting R. P. Conley, local store manager, are Verda R. DuBose, Fred R. Luther, James E. Redd and Philip E. Slater Jr.

Crutcher-Rolfs-Cummings Appointed Esco Dealer

Crutcher-Rolfs-Cummings, Inc. of Houston has been appointed an ESCO construction equipment dealer by Electric Steel Foundry Company. C-R-C will handle the full line of ESCO dragline buckets, shovel dippers, Fastback hoe dippers, material handling orange peels and clamshells, cutting edges, Dozer-rooters, bucket repair parts and two piece teeth.

Newest products in the line are ESCO trencher teeth, a Shellcast patented tooth noted for quick-change feature and long life.

Byron Jackson Pumps Appoints 3 to Regional Manager Posts

Byron Jackson Pumps, Inc. has announced new appointments for three men in the Los Angeles and Houston regions.

R. A. Winsryg has been named regional manager of the Los Angeles region; E. L. Lindsey takes over as regional manager of the Houston area; and Dean De Graffenreid is appointed assistant regional manager in Houston.

Bristol Opens Western Office, Names R. G. Tower Manager

The Bristol Company has announced the opening of a new western sales office in Denver, Colo. R. G. Tower, now manager of the company's Chicago office, will be manager of the new district office.

R. G. Tower

Tower has been with Bristol since 1922, when he joined the sales force at the New York office. Since then he has been manager of the St. Louis and West Coast offices, prior to moving to Chicago in 1940.

Wynn Elected Vice President For W-K-M Manufacturing

Robert O. Wynn has been elected vice president of manufacturing for W-K-M Manufacturing Company.

Robert O. Wynn

Wynn joined W-K-M as chief engineer in 1951. After the company was made a subsidiary of ACF Industries, Incorporated, he was appointed general manager of the ACF Valve division in Detroit. He returned to W-K-M as director of manufacturing when ACF Valve division and the Key Company were consolidated with W-K-M.

Lincoln Electric Announces $8 Million Expansion Program

The Lincoln Electric Company, Cleveland, Ohio, has announced an $8 million expansion to its plant capacity for manufacturing arc welding machines and electrodes. Work is underway to complete $2 million of this expansion by the end of the year. The entire project is expected to be completed within the next three years.

The program provides 60 percent more manufacturing capacity in the company's five-year old Cleveland plant. Extensions will be made to the building for new facilities and new equipment will be installed in existing production areas. The firm is also building new plants in France and Australia and adding to its Canadian plant.

Russell L. Sylvester Joins Rockwell as Chief Engineer

Russell L. Sylvester, formerly with New York Air Brake Company, has joined Rockwell Manufacturing Company as chief engineer of its Central Valve Research and Development department in Pittsburgh.

Russell L. Sylvester

Sylvester spent a number of years as director of project engineering, Kinney Manufacturing Company, division of New York Air Brake. He also was manager of engineering, National Research Corporation.

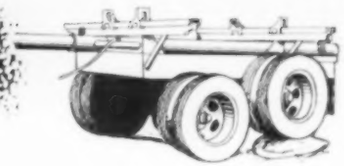
Buda Division of Allis-Chalmers Bought by Western Railroad Supply

Western Railroad Supply Company, Chicago, has purchased the railroad supply business of the Buda division of Allis-Chalmers Manufacturing Company.

Products to be manufactured and sold under the WRRS trademark include the complete line of jacks (ball bearing screw, journal, hydraulic, ratchet and rail bender), car and locomotive replacers, track liners, bumping posts, car stops, rail and bonding drills and the universal diesel nozzle testers.

Western Railroad Supply is expanding its offices and plant in Chicago to accommodate the acquisition of the Buda business. The remainder of Buda division's

CROSS COUNTRY



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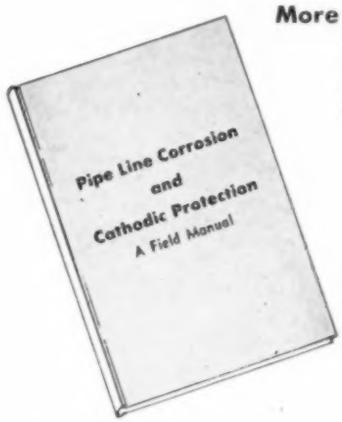

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It presents comprehensive data on Soil Resistivity Surveys, Potential Surveys, Line Currents, Current Requirements, Rectifier Systems, Ground Bed Design, Magnesium Anodes, Stray Current Electrolysis, Interference in Protective Systems, Operations and Maintenance, and Coating Protection and Testing.

An appendix has been added of technical data on Underground Corrosion, Basic Principles of Cathodic Protection, Properties of Metals and Attenuation Equations. Order copies of this practical Field Manual now for each of your field men. Price $3.

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products are not involved in the transaction. Gasoline and diesel engines, material handling and earth boring equipment will continue to be manufactured at the Harvey, Ill. plant.

Barton Instrument to Distribute Librascope Flow Computer

Librascope, Inc., Commercial Division, announces that the Barton Instrument Corporation of Los Angeles will distribute the new Librascope Flow Computer line.

The Librascope Flow Computers are pressure compensated totalizing devices for orifice measurements of fluids. The Librascope units will be incorporated into the Barton instrument line. Field tests have been completed and the Flow Computers are now being mass produced by Librascope.

Willes Named to Position With New Rockwell Division

Weldon D. Willes, product manager, Nordstrom valves, Rockwell Manufacturing Company, has been named assistant to the president of Rockwell's recently acquired Locomotive Finished Material (LFM) division, Atchison, Kansas.

W. D. Willes

Willes' chief assignment will be the coordination and integration of Rockwell products into existing LFM production.

Former general manager of Rockwell's valve manufacturing plants at Barberton, Ohio, and Oakland, Calif. Willes moved to the company's Pittsburgh headquarters as product manager in 1954.

He joined the Rockwell-Nordstrom sales force in 1947 and served as works manager at Oakland plant from 1950 to 1952, when he was named Barberton general manager.

Before joining Rockwell, he served with Pacific States Cast Iron Pipe Company in Utah, and Dalmo Victor Company and Hammond Aircraft Company in California.

Walworth Company Promotes Tredinnick and Wadsworth

Vernen A. Tredinnick, manager of Walworth Company's Kewanee, Ill., works, has been promoted to the recently established position of assistant vice president in charge of inventory planning and control. Arthur C. Wadsworth, manager of the company's East St. Louis works, has been advanced to manage the larger Kewanee plant.

Tredinnick will make his headquarters in New York. Wadsworth will move to Kewanee, but will maintain interest in the management of the East St. Louis works.

Tube Turns of Canada Acquires Ontario Plant

A one-floor plant at Ridgetown, Ontario, has been purchased by Tube Turns of Canada Limited. The plant is served by major railroads and trans-Canada truck lines.

Production facilities will be moved from nearby Chatham, Ontario, with J. A. Battist, manager, and most of the 40 employes being moved to Ridgetown.

Enterprise Engine Names Halpern Research Supervisor

Irving Halpern is the newly-appointed supervisor of research and development for Enterprise Engine & Machinery Company, San Francisco. He succeeds Charles Carmichael, who resigned.

Irving Halpern

Halpern is a ten-year veteran of diesel engineering research and design activity with Enterprise and for the past five years he has held the position of senior research engineer.

Tube Turns Buys Property For Expansion in Kentucky

Tube Turns has bought 13 acres of industrial property costing $2 million for expansion purposes in Louisville, Ky.

Formerly owned by the Louisville Transit Company, the property is adjacent to Tube Turns' main plant. Negotiations were handled by John G. Seiler, president of Tube Turns, and George O. Boomer, chairman of the executive committee of National Cylinder Gas Company, of which Tube Turns is a division.

U. S. Steel Names Manager And Field Representatives

U. S. Steel's Oil Well Supply division has announced the appointment of Winifred Berl Potts as manager of the store at Kermit, Texas, and the appointment of

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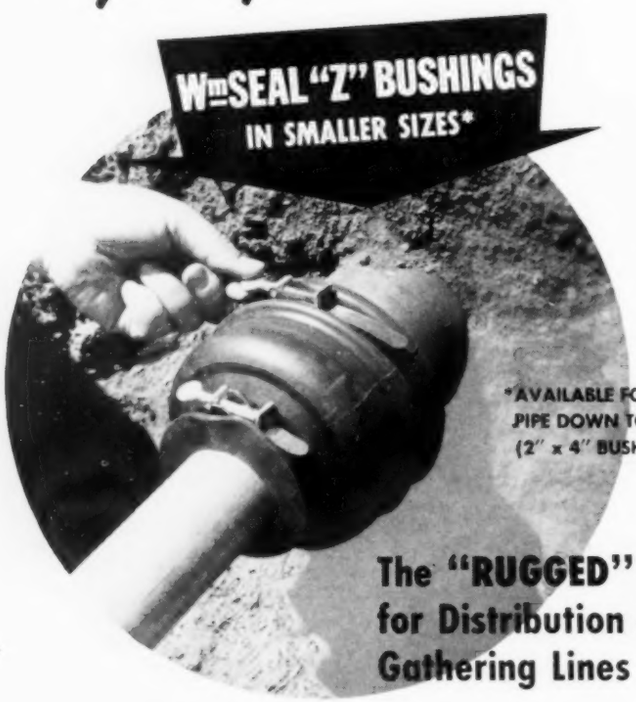

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Howard D. Harris and Clarence J. Schaefer, Jr., as field representatives. Harris will be located at New Iberia, La., and Schaefer at Big Spring, Texas.

Clark Bros. Appoints New Washington Representative

James B. Hickey has been appointed sales engineer of the Washington, D. C. office of Clark Bros. Company.

James B. Hickey

Before joining Clark, Hickey was associated with a manufacturer of heavy duty compressors. He was for six years with a firm specializing in pumping and automation equipment.

Hickey replaces William E. Dobbins, recently named Central Regional sales manager for Clark.

Canadian Pipe Mill to Be In Production in 1956

Welland Tubes, Ltd., Canada's first "Big Inch" pipe mill, is expected to be in production late this year. Early in 1957 the mill will start rolling the first of approximately 878 miles of 30-inch pipe ordered by Trans-Canada Pipe Lines Ltd. for its 2200 mile natural gas pipe line. Welland will supply pipe for the Winnipeg-to-Toronto section of the line.

The mill building now under construction at Welland will cover five acres of land and will be 684 feet long. A width of 317 feet at one end and 260 feet at the other will be required to accommodate the machinery. A joint venture of Page-Hersey Tubes, Ltd. and the Steel Company of Canada, the mill will produce steel pipe from 20 to 36 inches in diameter.

Challenge Manufacturing To Produce Heller Trenchers

The Challenge Manufacturing Company has announced the purchase of the Heller Manufacturing Corporation of Los Angeles. Production of the Universal Trencher previously made by Heller has been increased by Challenge to fill delivery schedules more promptly.

Trencher model 3A-48 is designed for mounting on the Oliver OC-3 tractor and is sold and serviced by the Oliver Corporation and their Industrial dealers. Model DA-48 mounts on the 40-C and the 420-C John Deere tractor and is sold and serviced by the John Deere Plow Co. and their dealers.

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Hallberg Hanson Named Manager Of Polyken Industrial Tape Plant

The Chicago Division of The Kendall Company has announced the appointment of Hallberg (Bud) Hanson as plant manager of the new $1 million Polyken industrial tape plant now under construction in Franklin, Ky.

Hallberg Hanson

Hanson, who has been with The Kendall Company since 1946, was most recently staff assistant to the production manager at the Chicago plant. His previous positions include assistant to the Polyken general sales manager and sales representative. Hanson is to assume his duties as plant manager in the fall.

Walworth Company Elects Hess Executive Vice President

Robert Graves Hess has been elected executive vice president of the Walworth Company. Hess recently resigned as executive vice president of Pesco Products division, Borg-Warner Corporation, to accept the Walworth position.

Hess was in charge of all activities of Pesco Products division, including operations, engineering, accounting and sales. Prior to that time he was general manager of the New York Air Brake Company, Watertown, N. Y. and president and director of Kinney Manufacturing Company.

Suardi Named by Graver To Head San Francisco Office

John M. Suardi has been named by the Graver Tank & Mfg. Co., Inc. to head its San Francisco sales office.

John M. Suardi

Suardi has been Graver's field service engineer with special attention to all types of conservation tankage. In his ten years with Graver, Suardi has been sales coordinator, production control supervisor and assistant manager for procuring steels and alloys.

Allis-Chalmers Power Units Available Through Dealers

Allis-Chalmers Mfg. Co., Tractor Group, announces that all models of Allis-Chalmers oil field engines and power units manufactured at its West Allis, Wis., works and Harvey, Ill., works are now available to the petroleum industry through all of its engine dealers.

These include the Models B-125 and W-226, available formerly through Fred. E. Cooper, Inc., Tulsa. The Cooper firm continues to represent Allis-Chalmers in the Tulsa area and will now handle sales and service of the line of natural gas, butane, propane diesel and gasoline engines in sizes from 9 to 516 horsepower.

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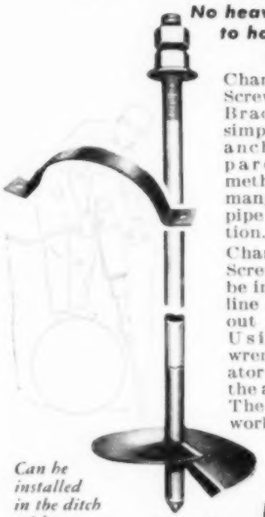

Chance Pipe Line Screw Anchors and Brackets greatly simplify pipe line anchoring, compared to other methods, and save many dollars in pipe line construction.

Chance Pipe Line Screw Anchors can be installed in pipe line ditches without extra digging. Using a power wrench the operator merely guides the anchor in place. The tool does the work.

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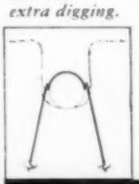

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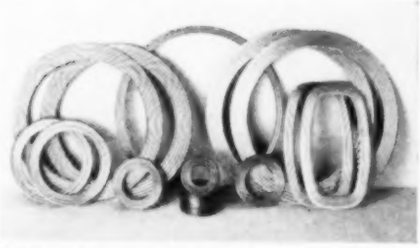

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Pittsburgh Industrialist Knighted by Italian Government

Col. W. F. Rockwell

Col. Willard F. Rockwell, board chairman of Rockwell Manufacturing Company and Rockwell Spring & Axle Company, has been knighted by the Italian government in the order "Al Merito Della Republica."

The honor, usually reserved for Italian citizens, was conferred by Vice Counsel Carlo M. Rossi-Arnaud on behalf of the president of Italy.

Dr. Rossi cited Col. Rockwell's contributions to Italy's reconstruction and economic recovery since World War II, and his efforts to promote closer economic relations between Italy and the U. S.

Seven Men Receive Sales Posts With Jones & Laughlin Supply

The Field Sales division of Jones & Laughlin Supply division headquartered in Tulsa has announced the recent appointment of seven men to key positions in Jones & Laughlin store points in five sales districts.

C. W. Moore, formerly a salesman in the West Texas district, has been appointed supervisor of store construction and maintenance for the Supply division. He will continue to maintain office headquarters in Odessa, Texas.

Ben E. Irby has been advanced from storeman to local store manager at Gladewater, Texas, in the East Texas district.

In the Louisiana Gulf Coast district, Bill E. Trisler, formerly manager of the Lake Charles, La., store, has been assigned to the division's newly-constructed store at Morgan City, La., as local store manager. Succeeding Trisler at Lake Charles is Vincent P. Panepinto, formerly a storeman at Harvey, La.

In the South Rocky Mountain district, Marion D. McAfee, formerly a storeman, and Curtis L. Sample, formerly a salesman, have been promoted to local store managers at Sterling, Colo., and Casper, Wyo., respectively.

Billy J. Cox has been made local store manager at Estevan, Saskatchewan, in the firm's Canadian Eastern district. Cox was formerly storeman at Anson, Texas.

See Composite and Refinery Catalogs, or Write for Specifications Folder

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What's New in Equipment

for the Pipe Line Industry

Pipe Line Dredge

Ellicott Machine Corporation has developed a new hydraulic pipe line dredge. The dredge is especially designed for the digging and maintenance of narrow canals, channels and irrigation ditches or for any dredging job where maneuverability and small size are essential. The dredge comes in 6, 8, 10 and 12-inch sizes. The smallest model, whose reinforced stress-resistant steel hull is 28 feet long, 11 feet wide and 3 feet deep, can work in close quarters only slightly wider than its own width, as can the dredges of the increased sizes. All of these machines dig their own flotation and low superstructure permits passing into areas formerly inaccessible to hydraulic dredges.

The dredge has complete hydraulic control for all operations from a single control panel. The hydraulic circuit is made up of one dual hydraulic pump, five fluid motors and nine hydraulic cylinders. A diesel engine supplies prime power to the dredging pump and for the hydraulic pump, which provides a system pressure of 2000 pounds per square inch maximum. The machines have horsepowers varying in degrees from 60 to 200, depending on the size.

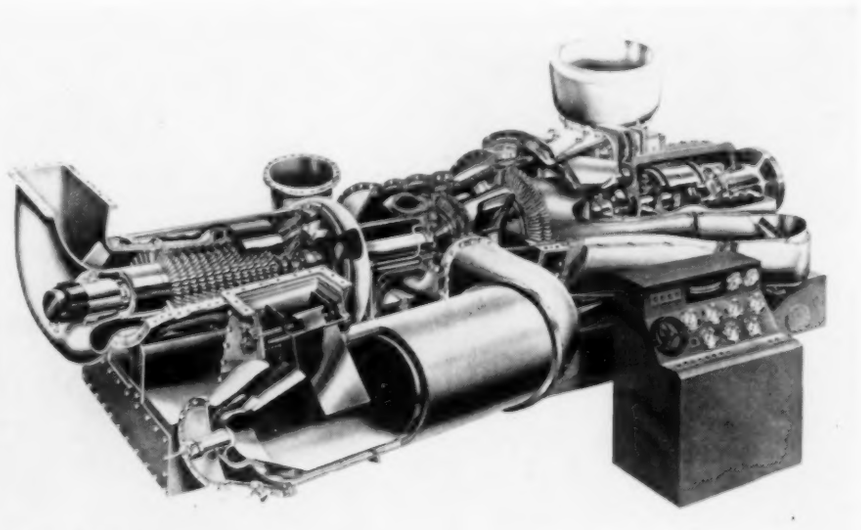
This swinging ladder-type dredge has the ladder assembly attached so that in addition to vertical movement, it also swings laterally. This eliminates the great width needed for the dredge to swing in making the arc of a cut and permits the hull to remain stationary. Positive control of the ladder movement insures an accurate cross section and smooth canal contour.

The canal "Dragon" needs no auxiliary motive equipment from land near the waterway where it is being used. The six-inch canal dredge can dig 30 to 60 cubic yards per hour, depending on the type of material being moved. It can transport the material at the side of the channel or up to 200 feet away.

The "Dragon" dredge is equipped with a suspended discharge pipe which allows material to be placed behind a berm at the side of the canal without additional pipe line. Elevated 13 feet above the water line, the reach of the pipe from the side of the dredge is 25 feet. The discharge pipe can also function as a rudder. By placing the intake pipe in the water, the pump can eject the water with sufficient force to move the machine and with the discharge pipe operating on a swivel, the dredge becomes self-propelled and guided.

For more data circle **No. E1** on Readers' Service Card, last page this issue.

Gas Turbine



Clark Bros. Co. has completed an agreement with Ruston-Hornsby Ltd. of Lincoln, England, for the manufacture and sale of the Ruston Mark TA gas turbine in the U. S.

The Mark TA, which develops 1130 brake horsepower, is similar in design to the Clark Type 302, 8500 BHP gas turbine. More than 40 of the Mark TA turbines and 13 of the type 302 turbines are operating or will be placed in operation soon in various applications. Typical areas of use are gas and fluid transmission where the variable speed or high starting torque characteristics of a two-shaft turbine are required.

The Mark TA gas turbine operates on a simple, open cycle. It is a dual shaft, series flow unit which develops 1130 BHP at 80° F. and 1000 feet. The nominal low pressure or output turbine speed is 6000 revolutions per minute. Output speeds of 1500 and 1800 rpm are available for driving 50 or 60 cycle generators. These speeds are obtained through the use of built-in planetary gears.

Variations of the low pressure turbine speed in either direction from the standard 6000 rpm will result in a slight variation in power output for a given turbine inlet temperature.

Temperature and altitude have the usual influence on the turbine rating. A 3.5% reduction of output is required for every 1000-foot increase in altitude; a 5% reduction or increase for every 10 F above or below 80°F.

The turbine is designed for normal operation at an inlet temperature of 1340° F. for long life and dependability. The design permits full load within two minutes of initiating starting cycle.

The complete turbine weighs approximately six tons and is readily portable.

(This item supplements Clark Bros. Co. data on pages 1290-1291 of the Composite Catalog, 21st Edition.)

For more data circle **No. E2** on Readers' Service Card, last page this issue.

A *New* BALANCED L.P.G. SAFETY VALVE

SHOWN here is the new S. & J. Hydraulically operated BALANCED Internal Safety Valve, which will remain in a closed position against various combinations of tank, line or manifold pressures. Since there is equal pressure on both sides of the cylinder bottom plate, this valve has been so designed that the area over which this pressure acts in the downward direction is greater than the area over which the pressure acts in the upward position. The result is that the force in the downward direction tends to seal the valve tighter with increasing line pressure. These valves are made in 3", 6" and 8" sizes. The 3" size operates with a single piston, while the 6" and 8" sizes employ a double piston to minimize the amount of hydraulic fluid required. Complete data and drawings on these valves and actuating hydraulic operators is contained in our new catalog HVS-HP, available upon request.

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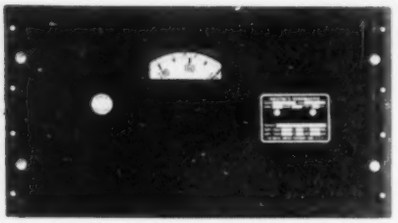
MEXICO, D.F.: Dalma Comercial, S. A.
CARACAS: Sinclair Spence, C.A., Edificio Galipan
ENGLAND: Whessoe, Ltd., Sales: 25 Victoria St., London S. W. 1
Whessoe, Ltd., Works: Darlington, County Durham

more data on advertised products, use Readers' Service Cards, last page.

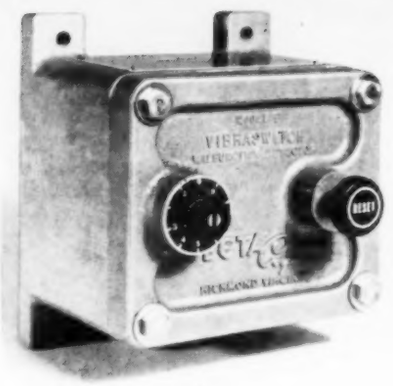


Electronic Potentiometer

A new electronic potentiometer, a measuring instrument equipped with a pneumatic transmitter which sends a 3-15 pounds per square inch proportional to the measured variable, has been announced by The Bristol Company.

The new Dynamaster pneumatic transmitter is available in either potentiometer or bridge circuits and will measure any variable which can be translated into an electrical quantity. It then converts the measurement into a universal 3-15 p.s.i. pneumatic signal for transmission to a remote pneumatic indicator or recorder, or automatic controller. Thus, it is possible to present measurements such as speed, viscosity, pH, resistance, smoke density, current and voltage, frequency and conductivity on the new miniature pneumatic receivers, along with more conventional measurements of flow, pressure and temperature.

For more data circle **No. E3** on Readers' Service Card, last page this issue.



Vibration Monitor

The Beta Corporation's new automatic Model 5 Vibraswitch malfunction detector anticipates and prevents trouble in rotating and reciprocating machines by responding to slight increases in roughness or vibration and causing a shutdown before a costly failure occurs. Examples of detectable malfunctions are failing bearings, bent shafts, unbalance, broken blades, etc. Applications include pumps, motors, compressors, blowers, gas engines, diesels, centrifuges, turbines, generating equipment, test stands. It may be used singly on small equipment; in pairs on driving and driven equipment, or in series or parallel combinations to monitor each bearing. Acceleration range is 0-2G's to cover all types of rotating equipment at speeds up to 18,000 revolutions per minute.

The Model 5 Vibraswitch includes a shock-free holding and reset mechanism for automatic or remote operation to prevent actuation from starting or from normal or accidental transient shocks. The unit employs no vacuum tubes or electronic components and requires no maintenance. It is available for either hazardous or outdoor locations.

For more data circle **No. E4** on Readers' Service Card, last page this issue.

Flowmeter

Industrial Development Labs. Inc., manufactures an Electro-Caloric flow meter for measurement and control of the mass rate of flow of liquids. In this instrument the rate of heat transfer through the boundary layer of a liquid is utilized to obtain a measurement of flow.

The instrument is suited for corrosive fluids and gases, slurries, hydrocarbons, biologics, beverages and has many applications in the chemical, pharmaceutical and food processing industries. It meets sanitary and safety requirements and its linear scale covers a wide range of flows including pulsating ones. Measuring elements are not exposed to the fluid and there is no pressure loss nor danger of clogging.

For remote indication and control a directly produced electrical signal is available. The device is fully electronic without mechanically moving parts. The flow indicating instrument has a 16-inch long easy to read scale. The flow totalizing instrument is the convenient watthour meter. The power consumption is under 100 watts.

For more data circle **No. E5** on Readers' Service Card, last page this issue.

AN-SPEC *Means Quality*

Cathodic Protection, Service, Construction and Engineering

It takes QUALITY if you're going the cathodic protection route against corrosion. AN-SPEC is the top quality magnesium anode — it's spectrographically analyzed . . . high purity guaranteed. And Pipe Line Anode Corporation offers every service — by most experienced personnel — to give you quality-controlled cathodic protection.

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11525 East Colfax, Denver (Aurora) Colorado
858 Wilson Avenue, Newark, New Jersey
912 West 11th, Houston, Texas
Distributor: Crose-Curran, Ltd. . . . Edmonton, Alberta . . . Phone 3-5135

Eleven 22-B's help beat time, terrain, low temperatures on Canadian gas line

Majestic Contractors Ltd., a fast-growing, fast-moving Canadian construction company, recently completed a 226-mile pipeline from the gas fields near Coleville to Prince Albert in Saskatchewan. It was finished on time despite difficult terrain, tough river crossings, and sub-zero temperatures.

Eight of the eleven Bucyrus-Erie 22-B excavators working on the spread were assigned to the toughest trenching jobs. On the St. Louis crossing of the North Saskatchewan River, large boulders — too large to be handled by the suction dredge preparing the river ditch—were encountered in the path of the trench. Two 22-B's — a dragshovel and a clamshell — were positioned on a barge to do the boulder digging. On land, too, some sections of the line were underlaid with boulders of all sizes. These sections, and also road and railway approaches, were handled by four 22-B dragshovels and two 22-B clamshells.

This kind of performance from Bucyrus-Eries is typical on pipeline spreads. You get dependable on-the-job performance because Bucyrus-Erie designs and builds for quality every step of the way. For your next pipeline job, put Bucyrus-Eries to work helping keep costs down, jobs moving on schedule. Your nearby distributor has all the facts.

236E56

Bonus Quality Bucyrus-Erie starts with highest quality steel, then carefully flame hardens it like this to bring you gears and pinions that wear longer, keep maintenance costs low.

BUCYRUS ERIE

BUCYRUS-ERIE COMPANY

SOUTH MILWAUKEE, WISCONSIN

Welding Electrode

The Lincoln Electric Company has announced a new E-6010 electrode, Fleetweld 5-P, suitable for all E-6010 applications, but especially designed for pipe welding. Pipe welding, especially on root passes with a "vertical up" technique at low currents, necessitates smooth arc operation, deep penetration and good bead wash-in, characteristics found in the new electrode. This electrode also provides minimum slag interference, resulting in quick freezing of the molten metal and less tendency for "windows" and porosity.

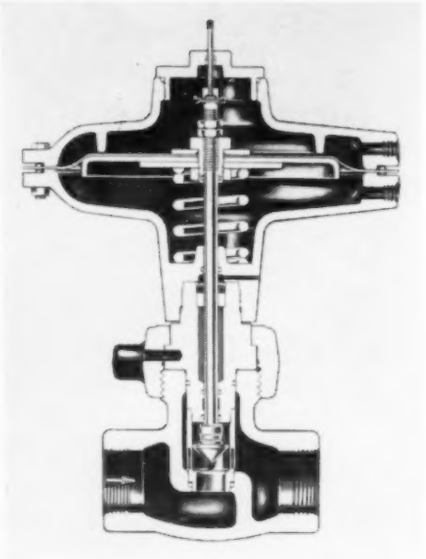
Fleetweld 5-P can be used for welding pipe, pressure vessels, X-ray applications and other ASME code work. It also is suitable for all-position structural welding, machinery weldments and ship welding. The Fleetweld 5-P is available in 1/8-inch and 5/32-inch diameters.

For more data circle **No. E6** on Readers' Service Card, last page this issue.

Field Valve

A new field valve designed for high pressure oil production work has been announced by Fisher Governor Company. The Series 125P diaphragm control valve is unusually small in size (largest size is less than two feet in over-all height), yet rugged enough to withstand 2000 pounds per square inch pressure.

Featured in this control valve is the interchangeability of topworks on all body



sizes and the ease of reversing the topwork action without any additional parts. The field valve is available in one inch and two inch screwed sizes with angle or globe bodies, orifice sizes up to one inch.

(This item supplements Fisher Governor Company data on pages 1706-1707 of the Composite Catalog, 21st Edition.)

For more data circle **No. E7** on Readers' Service Card, last page this issue.

Alarm System

A new automatic remote alarm system offering audible and visible warning for abnormal process functions is announced by Sparton Control Systems Division, The Sparks-Withington Company.

The system works over a two-wire pair or single wire and ground return up to several miles. It produces a blast audible for more than 2500 feet.

Any condition that will operate a switch or relay will trigger the alarm. Complete alarm systems are available with standard sensing devices for altitude, high or low pressure, temperature and flow, electrical and physical load, intrusion or position. The basic alarm unit is also available for integration in other control or alarm system.

For more data circle **No. E8** on Readers' Service Card, last page this issue.

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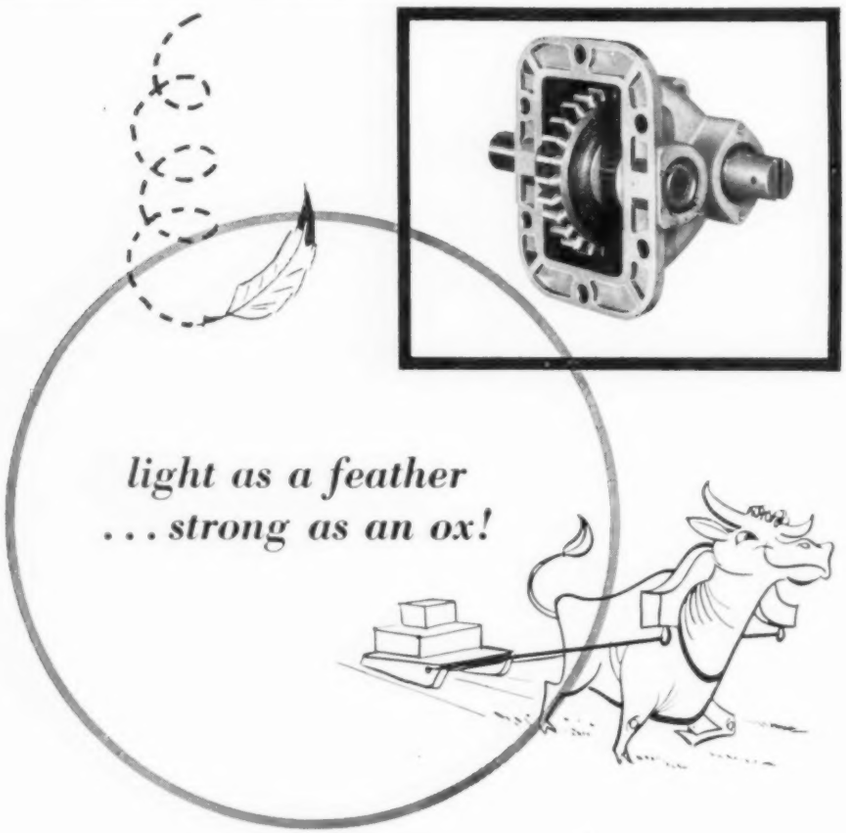


THE *NEW TULSA*® POWER TAKE-OFF

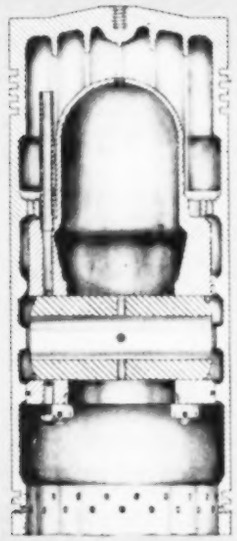
SINGLE SPEED • MEDIUM DUTY

Extremely light . . . you can hold it in the palm of your hand . . . because the NEW TULSA Power Take-Off has a die-cast aluminum housing which at the same time gives all the ruggedness and durability for which the TULSA line is famous around the world. Output shaft available in three sizes—13/16", 7/8" and 15/16"—and rotates on two needle bearings. Furnished with either cable or lever control to suit individual operators' requirements. Designed and built for the full range of medium duty work, this new power take-off offers the extra advantage of low price, nationwide distribution and service that have made the TULSA line a favorite everywhere.

Tulsa Winch
TULSA, OKLAHOMA DIVISION OF VICKERS Inc.

Let Us Give You The Facts About

NIMCO *HANGER TYPE* **PISTONS**



for ALL INDUSTRIAL ENGINES!

Successful users are the biggest boosters of NIMCO Hanger-Type replacement Pistons. If you operate large Diesel or Gas Engines, you should know their advantages too!

The NIMCO Hanger-Type Piston, incorporating a full-floating wrist pin, insures efficient oil cooling from below the pin to the top of the piston. This permits more uniform structural design of the piston body. No modification of companion parts is required for installation.

CALL OR WRITE TODAY FOR THE COMPLETE STORY!

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MANUFACTURERS — ENGINEERS
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Do you keep your fingers crossed?

—every time you start one of your gas engine driven compressors? Many a starting air piping system has been blown into shrapnel by a lubricating oil vapor explosion. The possibility of this can be obviated by installing a Campbell Centrimpact separator. Price, $300.00, f.o.b. Long Beach, California. This is *not* a filter but a combination of centrifugal and impact design which throws out the finest mist particles and isolates them from the flow. We can state without fear of contradiction that CENTRIMPACT IS THE MOST EFFICIENT MIST EXTRACTOR EVER BUILT.

Send for our paper on "Explosions in Starting Air Piping Systems."

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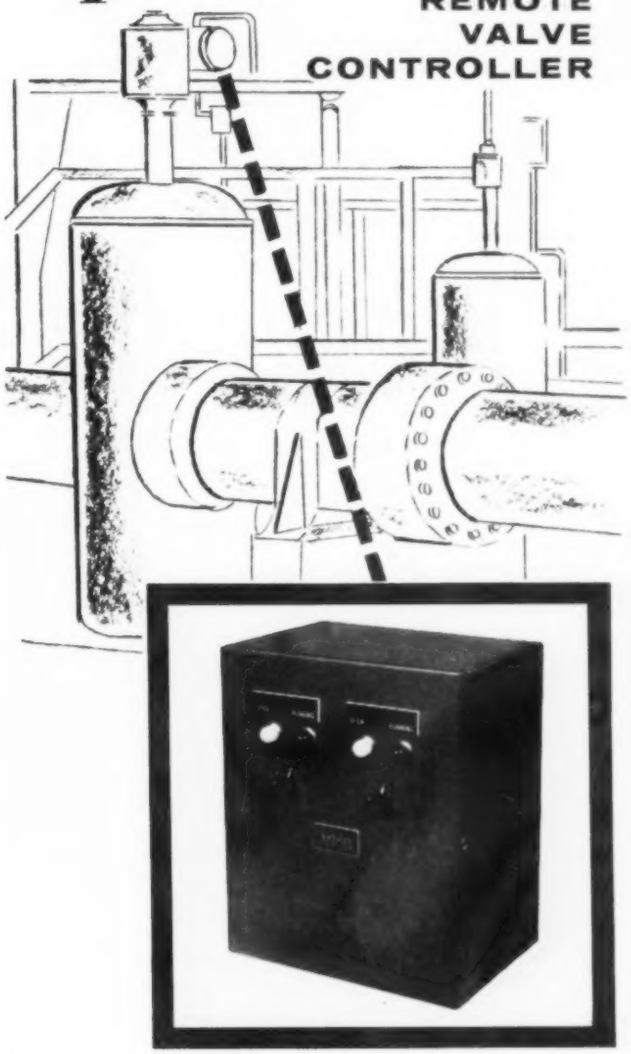
Sparton

REMOTE VALVE CONTROLLER



For Finger-tip Control Over Many Miles

Utilizes either a two conductor or single conductor and ground interconnection for long distance control. Employs DC impulses for remote open-close or proportional control of practically any valve.

Basic system provides valve status lamps on master control unit. Plug-in modules are easily added to provide additional supervisory lamps such as power failure; disagreement, control line failure.

Proven by use in many major pipe lines.

FULL STORY IN NEW BROCHURE

SPARTON CONTROL SYSTEMS DIVISION
The Sparks-Withington Company
Jackson, Michigan

Please send brochure

Name_____
Title_____
Company_____
Street_____
City_____ State_____

A New Concept in

FULL-FLOW Filters...

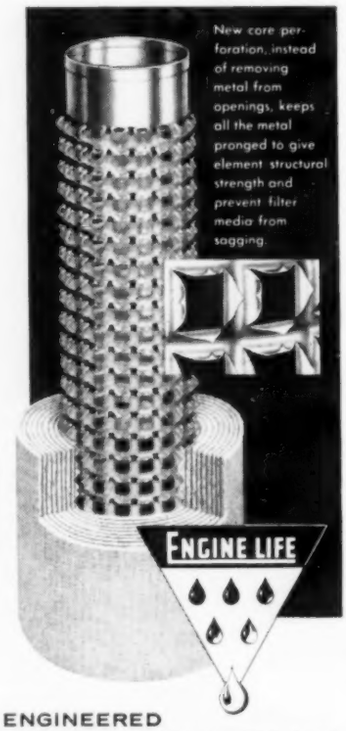
ENGINE LIFE *Maxiflo*

UNRESTRICTED CORE

DESIGNED TO GIVE MAXIMUM FLOW AND FILTRATION

Conditions oil without restricting flow

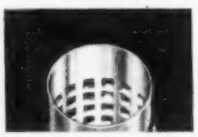
Here's a brand new ENGINE LIFE exclusive that gives unrestricted oil flow without sacrificing strength. This new core development which required research and development of special machines and tooling right in our own plant, gives you the finest full flow oil filtering yet. Now, even the most viscous lubricating oils and fuels are filtered perfectly. Because core openings can handle up to 10 times the oil pumped through the system, the most excessive surges are easily handled, thereby protecting the hydraulic system from undue restriction and ultimate failure. All integral parts of the new Maxiflo core are of non-corrosive metal.


New core perforation, instead of removing metal from openings, keeps all the metal pronged to give element structural strength and prevent filter media from sagging.
ENGINE LIFE

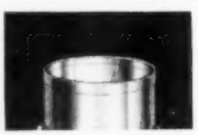
With Maxiflo, as in all Engine Life Elements, consistency in diameter and length is maintained

ENGINE LIFE elements operate without impairing the hydraulics of your engine. Better oil conditioning is achieved through the ENGINE LIFE absorption method of full filtration. All ENGINE LIFE elements are engineered to meet requirements of your application.

ENGINEERED FOR ALL REQUIREMENTS



Lubrication system flow rates are maintained by the free area ratio of perforation. Openings equal up to 10 times amount of oil volume pumped through engine.



Non-corrosive Metal Cores are end sealed with metal rings to insure trueness, add lip strength.

ENGINE LIFE *PRODUCTS CORPORATION*

EL MONTE, CALIFORNIA

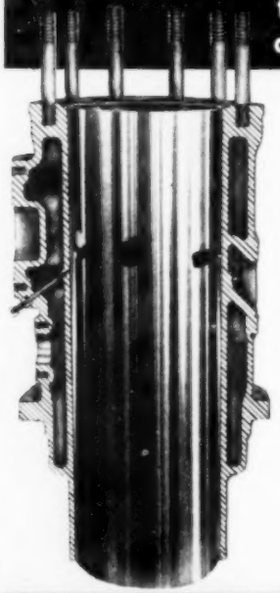
ENGINEERED FILTRATION SERVICE

INDUSTRIAL AUTOMOTIVE MARINE & AGRICULTURAL

✓ Check the Advantages of

NILINED CYLINDERS

for ALL ENGINES and COMPRESSORS!



NILINED Cylinders are not merely "lined" or "sleeved," but are tailored in every detail to the most exacting requirements. Each is fitted with a thin-wall liner of NIMCOLOY, a controlled process cast iron designed to insure the ultimate in wear-resistance and anti-scoring qualities. In every step of the rehabilitation process, skilled machinists and specialized machines combine to give you cylinders that will give longer, more trouble-free service than NEW cylinders!

Many types of cylinders are available on an exchange basis.

Call or write TODAY for more complete information!

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is SAFER

saves TIME

and MONEY*

**Say hundreds of pipeline workers using the Alston Ratchet Pipe Cutter.*

safer

The Alston Pipe Cutter completely eliminates sparks . . . no line explosions. No more time consuming pipe bleeding.

quicker

This tool cuts 10-inch pipe in less than 15 minutes. Roller guides eliminate broken cutters. The ratchet makes working in close places easy.

saves money

Begin to use this precision made cutter in your pipeline operation for safer, quicker, economical pipe cutting. Write for literature and prices.

ALSTON Manufacturing Co.

Livingston, Texas

P. O. Box 707 Ph. 226

New Equipment Catalogs and Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader's Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card. Requests are transmitted to the manufacturer as soon as received by us for mailing of desired information directly to you.

Pipelining

An illustrated booklet issued by Caterpillar Tractor Company shows the line up of Caterpillar pipe line construction machines, including heavy duty pipelayers, track type tractors, diesel engines and twin arc welders. Special features such as the hydraulic steering boosters, starting engines, dependable fuel injection and the constant mesh transmission are also discussed in detail.

To get a copy circle **No. E9** on Readers' Service Card, last page this issue.

Chemlon Products

A new brochure on Chemlon, "John Crane" products fabricated from DuPont Teflon, gives information on the applications for which it can be fabricated. Included in the text are data on properties, specification table and descriptions of fabricated products with operational and service data. Among the products described are mechanical and hydraulic packings in both braided and molded types; special hydraulic packings; FreeFlow envelope type and solid gaskets; O rings; flexible bellows, and others.

To get a copy circle **No. E10** on Readers' Service Card, last page this issue.

Trenchers and Backfillers

The complete line of Cleveland trenchers and backfillers, including the recently introduced Cleveland L-270 ladder-type trencher, is featured in the new bulletin of The Cleveland Trencher Company.

The L-270, one of the nine Cleveland models, is capable of digging a wide deep trench in alleys and other narrow areas where no excavating machine previously could work. Information on the capacities, specifications and dimensions is given to facilitate comparison of the models. Special advantages and design and construction aspects are covered in the text.

To get a copy circle **No. E11** on Readers' Service Card, last page this issue.

Pump Bulletin

A new bulletin covering the line of class CRV cradle-mounted centrifugal pumps has been announced by Ingersoll-Rand. Pumps described have capacities from 5 to 2000 gallons per minute and pressures of 10 to 525 feet total head. Performance tables and dimensions for the entire line are shown and modifications which are available for special applications given.

To get a copy circle **No. E12** on Readers' Service Card, last page this issue.

Design Pressures Handbook

An 83-page reference work for all gas pipe line engineers entitled "Design Pressures for Steel Pipe for Gas Transmission and Distribution Systems" has been issued by the Ladish Company. The new bulletin presents allowable working pressures conforming to recently revised Section 8 of the A.S.A. Code for Pressure Piping B31.1.8-1955. Design pressures for various grades of pipe in sizes 6 inches through 42 inches are numerically tabulated and plotted in chart form for each of the four basic types of construction covered in this standard. Ladish also has available a bulletin on multiple outlet headers and pipe line fittings developed by the company, as well as the Ladish general catalog containing information on the Ladish line of controlled quality pipe fittings which includes butt welding fittings, forged A.S.A. flanges, forged screwed fittings, forged socket-welding fittings, long welding necks, and large diameter and T.E.M.A. flanges.

To get a copy circle **No. E13** on Readers' Service Card, last page this issue.

Meter Runs

Two descriptive folders on meter runs and orifice plates are being distributed by Maintenance Mechanical Corporation, a subsidiary of Maintenance Engineering Corporation.

The company makes complete meter stations with valves, regulators, gas scrubbers, etc. Detailed dimensions and list specifications which should be included with an order are given in the two bulletins.

To get a copy circle **No. E14** on Readers' Service Card, last page this issue.

Control System Brochure

The Sparton Control Systems Division, The Sparks-Withington Company, has issued a four-page brochure covering plug-in package remote control system for two-position discreet operation of starters, pumps, valves, loaders, gates, operators, etc. The publication describes system and techniques.

To get a copy circle **No. E15** on Readers' Service Card, last page this issue.

Floating Roof Catalog

A new catalog and data book on the patented "Tubeseal" system for floating roof storage tanks has been published by Hammond Iron Works. The catalog describes the design and construction of the improved Hammond Tubeseal—the floating—roof seal that eliminates every space between seal and product. The Tubeseal, completely noncorroding, is illustrated in drawings and photographs and the catalog answers questions on design, construction, materials, applications, operation and advantages.

To get a copy circle **No. E16** on Readers' Service Card, last page this issue.

Ditcher Catalog

Gar Wood Industries has published a new catalog covering the recently introduced Gar Wood Buckeye 305, 307 and 308 pipe line and utility ditchers. The publication describes a number of new engineering developments, including the Gar Wood Buckeye hydraulic conveyor drive, live hydraulic wheel hoist controls, specially designed traction and digging transmissions and other features.

To get a copy circle **No. E17** on Readers' Service Card, last page this issue.

REPAIR LEAKS
QUICKLY—PERMANENTLY

SKINNER-SEAL PIPE JOINT CLAMPS stop leaks at joints. Put on under pressure—without interruption of service. Quick, simple, lasting repair. Sizes 1/2" to 24" incl. in stock.

SKINNER-SEAL COLLAR LEAK CLAMP—designed to stop every type of collar leak in oil and gas lines. Sizes: 2" to 13" inclusive.

M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA, U. S. A.

LIKE A BEE'S HIVE

REMCO PIPELINE EQUIPMENT IS ENGINEERED TO GET THE JOB DONE RIGHT!

Write for our complete FREE catalog

REMCO MANUFACTURING COMPANY

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112 Caterpillar tandem maintainer.

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Tube Turns, Inc. 23
Tulsa Gauge & Instrument Co. 114a
• Tulsa Winch Division
Vickers, Inc. 120

U

United States Steel Corp. 5
Universal Oil Products Co. 12

V

• Vickers, Inc. 120

W

• W-K-M Manufacturing Co. 90
W-S Fittings Division
H. K. Porter Co. 79
Walworth Co. 8
Westinghouse Electric Corp. 61
Wilkening Manufacturing Co. 73
T. D. Williamson, Inc. 112
• Wisconsin Motor Corp. 80
• Worthington Corp. 16

Y

The Youngstown Sheet & Tube Co. 10

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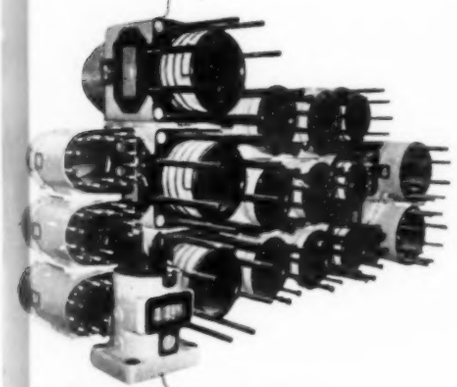

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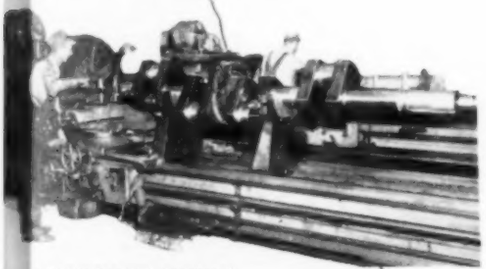

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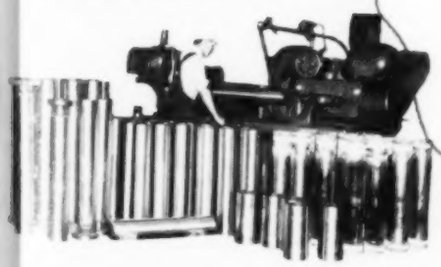

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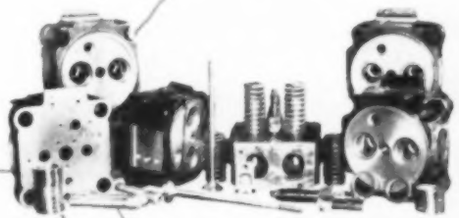
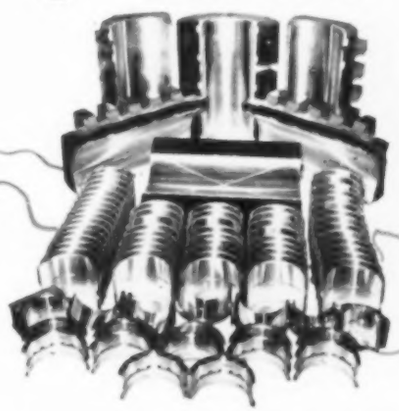


NIMCO CYLINDER HEADS and VALVE ASSEMBLIES



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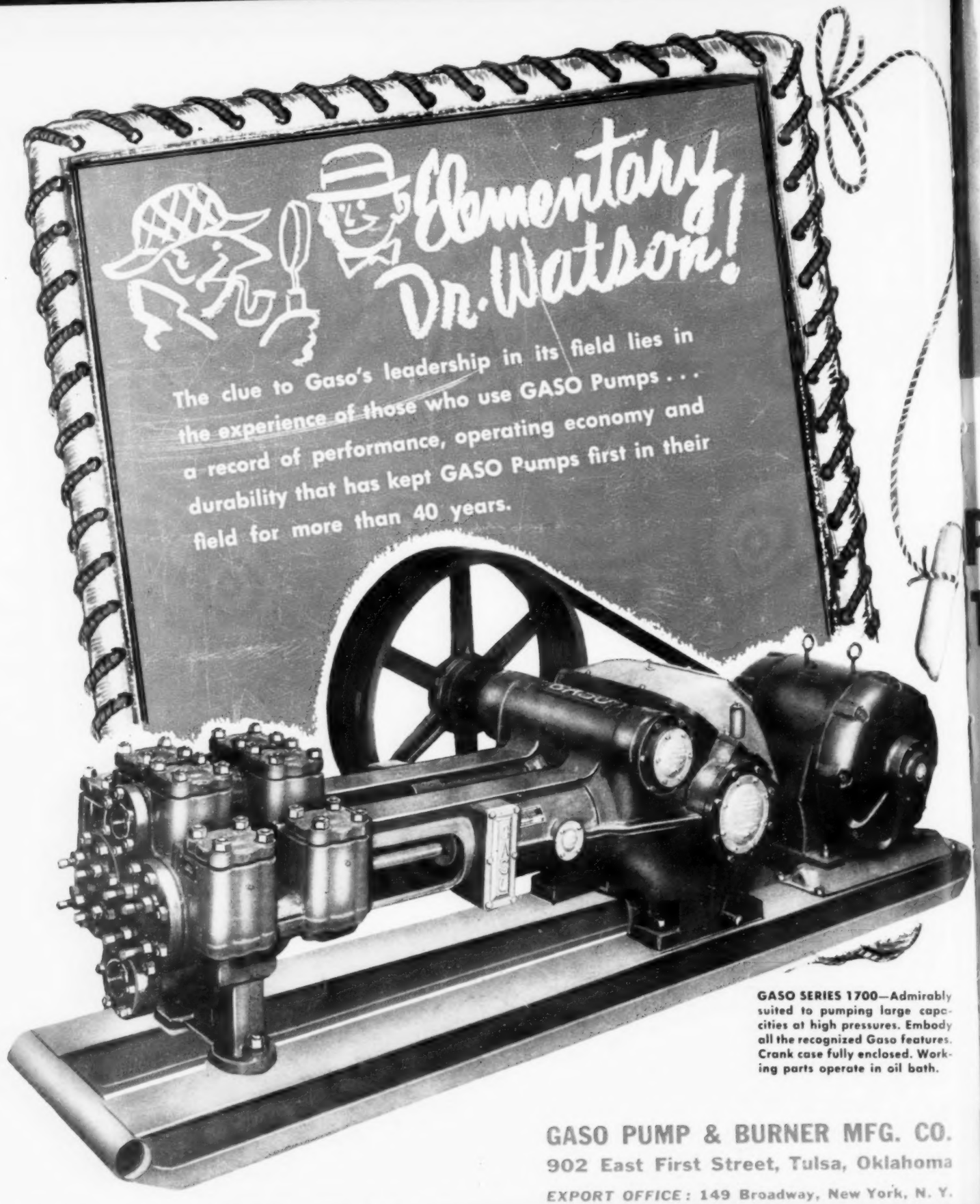
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